The Chemical Age

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Works Accidents and their Prevention

THE chemical industry is among the foremost in its regard for the health and safety of the worker, and its leaders are ever on the look out for methods of reducing yet further the number of accidents. It has been believed that accidents are always due to preventable causes, with the exception of a small proportion that would seem to come under the category called by insurance companies " Act of God "; and even these in many instances might have been preventable but for some carelessness or ignorance either in the victim or, indirectly, in someone responsible in the long chain of circumstances preceding the accident. Acting on this assumption the Association of British Chemical Manufacturers issued, in provisional form so long ago as 1929, a set of well over one hundred model safety rules for use in chemical works. These rules, wholly admirable in themselves, laid down principles for the design of plant, for the methods of operation, the conduct of the workmen and other germain matters. By putting such a book into the hands of all members of the staff to whom it could be useful, and, of course, insisting that the provisions should be carefully observed, a great deal of " accident due to ignorance " could be avoided.

Accident due to imperfections of plant remains untouched because there is no similar document in existence, so far as we are aware, laying down rules for the guidance of the manufacturers of plant, nor, one would imagine, would it be possible usefully to make rules of this character. To avoid such accidents it is desirable to purchase all plant wherein failure might involve serious consequences only from firms of approved reputation and known skill and to inspect it frequently during manufacture, not because of doubts of the skill and responsibility of the maker, but because risk of unsuspected error, often due to misunderstanding, is thereby minimised. The British manufacturer has a reputation for quality that he will not wittingly sacrifice—even with the modern craze for price-cutting in certain quarters.

When all has been done one cause of accidents yet remains. Stress has been laid upon the design, manufacture and methods of operation because whatever degree of importance be attached to the remaining causes, these must retain their significance in accident prevention. The remaining cause lies in the individual.

The most potent source of accident is generally supposed to be carelessness, which in its essentials is temporary ignorance due to forgetfulness either of scientific facts or, in those ignorant of science, of the rules laid down by the cognoscenti. Rather more than two years ago, when the Home Office published the first of its quarterly reports of industrial accidents, it was still believed that most of the accidents were due to " preventable causes." Last February the Chief Inspector of Factories began to express doubts. Investigations suggested that accidents were due to something inherent in the individual to which all individuals were not equally subject, and in a lecture he gave at that time, he used for the first time the term " accident-proneness." This conception of a special and personal susceptibility to accident has been further supported by the Health Research Board which has proved that in any occupation roughly three-quarters of the reported accidents happened to one-quarter of the people exposed to the risk. Mr. Eric Farmer, Reader in Industrial Psychology at Cambridge University, in a recent address, has shown that statistical research demonstrates that in any group of individuals exposed to similar risks the majority of the accidents involve only a small number of persons, and that " accident-proneness " is a relatively stable individual characteristic, which manifests itself whenever opportunity is given. This principle appears now to be well established and must be taken into account by all works managers. In selecting men to carry out the more difficult and the less safe tasks (we avoid the word dangerous under the modern conditions in industry), those men should be chosen who have a clean accident record.

Nevertheless, it is not certain whether accident-proneness cannot be overcome by training and experience. We have in mind a man who, as a young chemist, nearly blinded himself with caustic soda, who passed through several minor accidents in the laboratory, who, when sent into the works as a junior operating engineer immediately signallised himself by falling off quite a wide gantry and breaking his leg and who miraculously survived permanent mutilation upon other occasions. After some ten years of this hair-raising existence he seemed to discover how to take care of himself. He is now assistant works manager and, from his record, seems to have grown out of his accident-proneness. It is interesting to note that this man's brother was also accident-prone and had to leave the manufacturing side of industry as the result of injuries. It is probably important that no worker should have the suggestion of accident-proneness put too prominently before him. There are few things that will more readily induce accidents than fatalism. But the managerial staff should take it into account privately when allocating their labour force.

Notes and Comments

New Industries from Coal

AFTER 700 years of investigation coal remains largely a mystery to the chemist. It is not only desirable but of great importance that we should know the chemical structure of the raw material. Such knowledge is, in the opinion of Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, a key which, when found, will not only open the door of progress to existing processes, but will reveal new methods of treating coal by solvents, by heat and by chemicals, and eventually lead to entirely new industries. Speaking on coal, power and smoke in his presidential address to the Junior Institution of Engineers on December 13, Sir Frank foreshadowed new industries for the depressed mining areas as a result of coal research. Increased knowledge of chemical structure and of the various reactions which ensue when coal, or a part of it, is burnt, volatilised or dissolved will, he believes, lead to methods for obtaining products which at present do not exist. The production of liquid fuels should be cheaper, and no doubt lubricating oils will be made. It is well to remember that the motor industry, the aircraft industry, the rayon industry, the radio industry, the artificial nitrates industry and the hydrogenation of coal are all new in the lifetime of most of us, and they employ over a million workers. Sir Frank invites us to be optimistic and see in the picture of coal's future the use of deashed pulverised coal in internal combustion engines and new industries that science will produce with coal as the raw material. We share Sir Frank Smith's hope that at least some of these new industries will find a home in the present depressed areas, and that with such alternative occupation the shadow of unemployment will gradually disappear.

Carbon Bisulphide Dangers

ATTENTION has again been called by the Factory Department of the Home Office to the dangers of poisoning, fire and explosion in connection with the use of carbon bisulphide in artificial silk, india-rubber and other works. As recently as May of last year we published a fairly full summary of a memorandum of precautions which had then been issued by the Department. Within eighteen months a revised memorandum has been issued (Form 836, November, 1935.) Essentially the warnings contained in the memorandum are the same as those issued last year, and attention is particularly drawn to a number of exhibits at the Home Office Industrial Museum in London illustrating safeguards against the risks mentioned in the memorandum. Specific points in regard to the promotion of safety are illustrated by sketches of plant at the works of Dobson and Barrow, Ltd., the British Enka Artificial Silk Co., Ltd., and Imperial Chemical Industries (Rexine), Ltd. Considering the extent to which carbon bisulphide is employed in industry it is satisfactory to record that since poisoning cases became compulsorily notifiable, in 1924, only 18 cases have been notified (nine from artificial silk works, four from viscose paper works, three from india-rubber works, and three from works manufacturing carbon bisulphide.) If the warnings contained in the memorandum are heeded, even this low record can be beaten. The most important preventive methods are efficient exhaust ventilation, alternation and limitation of employment and periodic medical examination. Methods for removal of the vapour of carbon bisulphide must necessarily vary with the process. Regular change of employment to another process in which there is no exposure to carbon bisulphide is very important. While exposure in artificial silk works is to some extent intermittent, alternation of work, *i.e.*, one week in the churn room and the following week or weeks in another process, is advantageous and has been found practicable. Medical examination of workers exposed to carbon bisulphide, at intervals of not more than one month, permit of the doctor detecting any workers showing early signs indicating absorption of carbon bisulphide, and enable the more serious effects to be prevented. The findings of the examinations provide an additional check on the efficiency of the systems provided and maintained for the removal of the vapour.

Oil Wells in England

MR. NORMAN DUDGEON, who is chairman of the Kent and Sussex Oilfields Co., has compared the strata in Sussex with those that occur in Hanover and has found them very similar. The oil wells in Hanover are very flourishing, and in less than a year the English company will reach a depth of 2,200 ft., where it is hoped the first oil sand will be struck. Geologically there is no reason why the wells should not be extremely profitable, for the same company in 1931, in approximately the same area, reached a depth of 1,886 ft., and oil showed at no fewer than six points. However, it was believed that these were only seepages from below. The most important aspect of the enterprise is that it will yield valuable information to those interested in prospecting for oil in Great Britain, and may prove whether or not it is possible to run an English oil well on an economic basis.

Harrison Memorial Prize

THE Harrison Memorial Prize selection committee, consisting of the presidents of the Chemical Society, the Institute of Chemistry, the Society of Chemical Industry and the Pharmaceutical Society, has awarded the Harrison Memorial Prize for 1935 to Dr. Leslie Ernest Sutton. The prize will be presented at the annual meeting of the Chemical Society, at the University of Bristol, on April 16, 1936. Dr. Sutton was educated at Watford Grammar School, and proceeded to Lincoln College, Oxford, in 1925, obtaining his B.A. and B.Sc. in first class honours in 1929. He was elected senior research scholar of the Department of Scientific and Industrial Research in 1929, and obtained his D.Phil. and Fellowship of Magdalen College in 1932. He worked with Professor P. Debye at Leipzig and with Professor L. Pauling at the California Institute of Technology, Pasadena, and during the past five years he has been carrying out research at Oxford. His original investigations on dipole moments, including the relation between moments and orientation in benzene substitution; on valency angles, and on electron diffraction are of outstanding merit.

X-Ray Methods in Industry

By Dr. R. C. EVANS

THE discovery of X-rays by Röntgen in 1895 was followed 17 years later by a discovery of scarcely less significance and one which, if its importance is to be measured by the consequences to which it has given rise, must be reckoned as one of the most fundamental experiments in physics. The prediction by von Laue in 1912 that a crystal might be used as a diffraction grating for X-rays, and its subsequent experimental verification, not only terminated a lengthy and acrimonious discussion as to the nature of X-rays but also made available one of the most powerful tools which we have for the investigation of the solid state. It is not the intention of the present article to discuss the purely academic applications of this tool to the elucidation of the internal structure of crystals, as an elementary account of this work is found in every modern chemistry text-book. Here it is sufficient to say that the application of the X-ray methods has revealed that the crystalline state is far more widespread than was previously realised, and that, while the single crystal is an object of relatively rare occurrence, there are very few substances indeed which are not crystalline in the sense of being composed of a mass of minute crystals irregularly disposed. It is only necessary to say that all metals and alloys and all "chemicals" are crystalline in this sense, while even such substances as artificial silk, wool and rubber have a pseudo-crystalline character, to emphasise the technical importance of the X-ray methods and the field for their application.

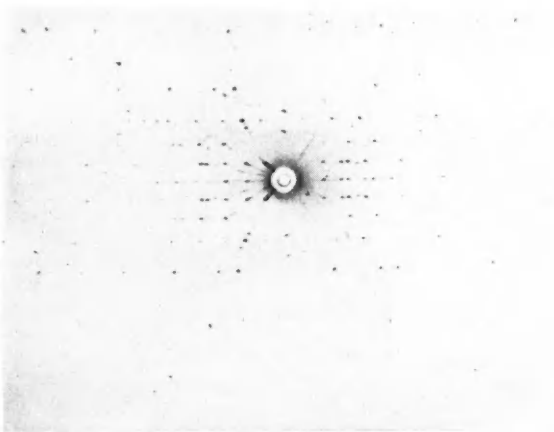

Fig. 1.—A Typical Rotation Photograph.

Diffractions of X-Rays

The diffraction of X-rays by a crystal is closely analogous to the diffraction of ordinary light by a grating, and depends upon the fact that a crystal provides a characteristic regular structure with a spacing comparable with the wavelength of X-rays. The fact, however, that a crystal has extension in three dimensions, whereas an ordinary grating is extended in only one, introduces certain modifications in the theory. The most important of these for our purpose is, that while an ordinary grating always gives rise to series of spectra when a beam of monochromatic light falls on it, a crystal diffracts monochromatic X-rays only when it is situated in one of a number of characteristic orientations. In consequence, when it is desired to obtain an X-ray diffraction photograph from a single crystal it is necessary to rotate the crystal in order that any diffraction effects may be observed. As the crystal passes successively through the various characteristic positions the diffracted beams flash out and are recorded as spots on the photographic film. Fig. 1 shows a typical "rotation photograph" obtained in this way.

A second method of X-ray analysis, and one which is of much more general applicability to the types of investigation with which we are here dealing, is shown in Fig. 2. Here, instead of a single crystal, a finely divided crystalline powder is used. It is now no longer necessary to rotate the specimen since there will be included in the powder crystals in every possible orientation. It is clear that such a photograph will be symmetrical about the direction of the incident beam and will, therefore, consist of a series of rings on a flat photographic plate placed at right angles to this direction. For the sake of economy it is usual to employ only a narrow strip of film along a radius of the figure. The position and relative intensities of the rings are characteristic of the particular substance under investigation and are of importance to those interested in the investigation of the crystal structure. Apart from the exact position of the lines, there are, however, other more detailed features of the diffraction photograph from which information of the greatest importance can be derived. As examples of the kind of information which can be thus obtained we may instance such problems as the determination of the grain size of small particles, the identification and chemical analysis of substances, especially when only minute quantities or impure specimens are available, the investigation of any preferred orientation of the micro-crystals, say, of an alloy, which may be imposed by cold working, and the detection of strain in solids. The application of X-ray methods to problems such as these has received very much less attention than the purely academic applications to the investigation of crystal structures, and it is often true to say that, through sheer ignorance of the power of the X-ray methods, many problems to which they are particularly suited are still being tackled by older and more tedious methods. It is the purpose of this article to illustrate by actual examples some directions in which X-ray methods have been successfully applied to practical problems. A sufficient variety of examples will be given to illustrate the wide scope of the methods, while little imagination is required to suggest many other fields in which they might be used.

Chemical Analysis and Identification

It has already been remarked that every crystalline substance gives its own set of characteristic lines in a powder photograph. A mixture of substances gives the lines characteristic of each of its constituents. Provided photographs are available of the pure constituents which a mixture is suspected to contain, the X-ray methods enable a qualitative, or even a rough quantitative, analysis to be made simply by comparing the photograph which the mixture yields with the several photographs of the pure constituents. The method is especially valuable when only small quantities of material are available, and has been applied to determine the nature of the active coating on wireless valve filaments. An investigation on boiler scale is illustrated in Fig. 3. The patterns due to pure Fe_2O_3 and Fe_3O_4 are shown in Figs. 3a and 3b respectively, while the photographs of Figs. 3c and 3d are due to scales removed from different depths below the surface. It is at once clear that the former is very nearly pure Fe_2O_3 while the latter contains both oxides with a preponderance of Fe_3O_4.

Very important work on the same lines has been done on alloy systems. A pure metal gives a set of lines which are

but little altered by the addition of a second metal so long as solid solution takes place. The appearance of a new phase, however, gives rise to an entirely new set of lines, and the exact extent of solid solution before the new phase is formed can be very accurately determined. In this way equilibrium diagrams of metal systems have been obtained with a rapidity and an economy of material altogether impossible by the older chemical methods.

Determination of Particle Size

It is clear from the description given above of the powder method of X-ray analysis that the method depends for its success on the crystal grains of the powder being sufficiently small for the specimen under investigation to contain particles of every possible orientation. It is found that in practice this condition is satisfied if the particles have linear dimensions not greater than about 10^{-3} cms. If the particles are substantially larger than this they are not sufficiently numerous to diffract uniformly all round the rings of the photograph, and the rings become broken up into a series of discrete spots; the fewer the spots the larger the grains. Fig. 4a shows a typical photograph obtained from a powder having large grains.

X-ray methods are not, however, restricted to estimating the size of these relatively large particles, for, just as a diffraction grating cannot yield a sharp spectrum unless the number of rulings is large, so a crystal cannot give a sharp X-ray spectrum unless its linear dimensions are large compared with the wavelength of the X-rays used. If the size of the particles producing a powder photograph is reduced below about 10^{-5} cms. the sharp lines of the photograph become more and more diffuse, and assume the appearance shown in Fig. 4b. This X-ray method is the only one available for estimating the size of such small particles. The

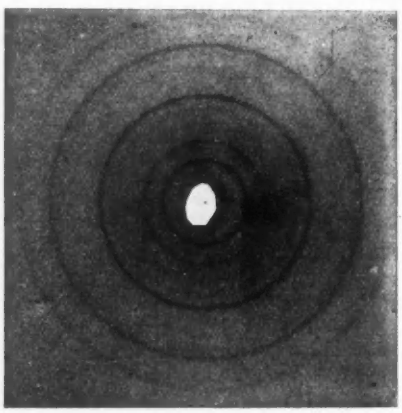

Fig. 2.

Fig. 3a.

Fig. 3b.

Fig. 3c.

Fig. 3d.

Fig. 4a.

Fig. 4b

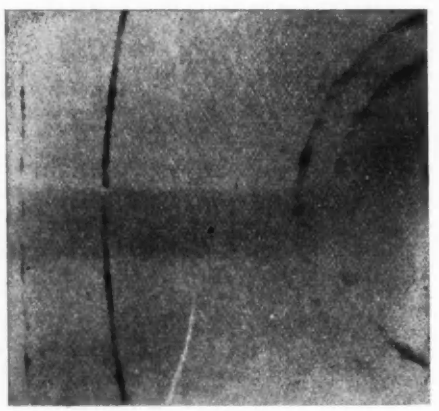

Fig. 5a.

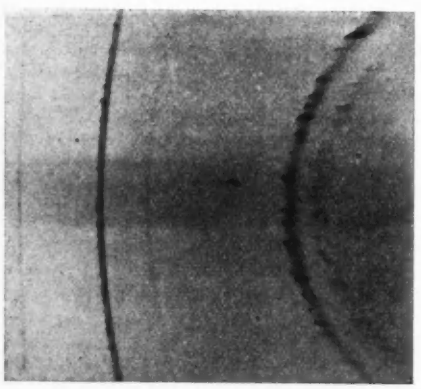

Fig. 5b.

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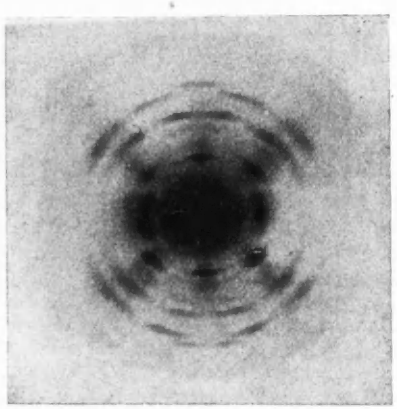


Fig. 6.

method has been widely applied to a variety of problems, typical among which we may instance an investigation into the physical properties of electrolytically deposited chromium. It was found that the brightest deposits were obtained when the deposited metal was composed of exceedingly minute particles. In the same way the efficient operation of catalysts has been shown in many cases to be dependent on the grain size.

Crystalline Perfection

Another field in which X-ray methods have been successfully applied is in the detection of strain resulting in a distortion of the crystal grains of a solid. If the particles of the material under investigation are distorted the lines or spots of the resultant photograph become blurred or diffuse in much the same way as the lines produced by very small grains. The effects are, however, in no way related for the broadening of the lines due to distortion may be observed even with coarse grained materials. The photographs of Fig. 5 illustrate this effect. Here the subject of the investigation was a silicon transformer steel. In both photographs the lines are composed of a series of discrete spots indicating the presence of relatively large crystal grains, but it will be noted that, while the line just to the right of the centre in Fig. 5a is in reality a doublet, the corresponding line in Fig. 5b is not resolved into two components. The specimen giving the latter photograph was in a state of high internal strain while that giving the former was composed of grains in a state of more perfect crystallisation. The hysteresis losses in this specimen were found to be considerably smaller than in the strained specimen. The method has been similarly applied to investigate the strains produced in welding and also those which arise in cold working operations such as wire drawing.

Crystal Orientation

Just as the presence of large crystal grains breaks up the lines of a powder photograph into a series of discrete spots, so also will any tendency on the part of the grains to orientate themselves in any particular fashion, for it is clear that any kind of preferred orientation destroys the condition of random arrangement essential for a powder photograph. The effect observed will differ, however, from that due to large grains in that the spots will no longer be more or less regularly distributed around the rings, but will be arranged in a way that will enable the exact orientation of the crystals to be determined. The effect is illustrated in Fig. 6 which is that produced by a sheet of rolled aluminium. Before rolling the picture obtained was similar to that of Fig. 1. In Fig. 6 the general trend of the rings can still be discerned, but the distribution of intensity is evidence of a very marked degree of orientation. Orientation is similarly produced in the process of wire drawing, and may, in some cases, be of great practical importance since the presence of orientated crystals bestows directional physical properties on the substance, so that, say, the strength or the electrical resistance may be markedly different in one direction from that in another.

* * *

Many further examples such as the above might be quoted, but sufficient has already been said to emphasis the power and versatility of the X-ray methods and the wide range of investigations to which they have been applied. The very small amount of material required (a satisfactory photograph can be obtained with considerably less than a milligram), the fact that impurities or foreign substances in no way disturb the observations, and the fact that experiments can be carried out without destroying the specimen and if desired actually on a manufactured article (a casting, for example) are all important factors commending these methods. Nevertheless, it is still true that the X-ray methods have not been utilised as extensively as should have been the case, and many lines of research to which they are particularly suited are still carried out by less satisfactory methods. In part this is no doubt due to ignorance of the scope of these methods, in part perhaps to the prejudice that they are very costly, and yet it may be reasonably claimed that all the investigations here described could have been carried out with an equipment costing no more than about £150. If this article dispels that ignorance or explodes the prejudice it will not have failed in its object.

Lac Research in England

Report of Progress, 1934-35

ACCORDING to the annual report of the London Shellac Research Bureau, for 1934-35, considerable progress has to be recorded in the research work proceeding in the United Kingdom on the application of lac products in industry. At the research laboratories of the British Thomson-Houston Co., Ltd., Rugby, under the able guidance of Mr. W. Bayley Parker, Dr. Ali Karim has been engaged principally on ascertaining the best type of extractor and the best type of extracting solvent for removing the wax from lac products and determining the quantity, with the view to standardising this test. A preliminary report has been submitted to the British Electrical and Allied Industries Research Association Committee concerned for consideration and transmission, if approved, through the British National Committee (the British Standards Institution) to the International Electro-Technical Commision.

Dr. R. Bhattacharya, assisted materially by the wide experience in research work of the director of the Paint Research Station, Teddington (Dr. L. A. Jordan), has worked steadily on the constitution of lac, and has been in consultation with the veteran German chemist, Dr. Werner Nagel, on the subject. Dr. L. C. Verman, in co-operation with Dr. Bhattacharya, has evolved a method of splitting up lac on a semi-commercial basis into its principal component parts, namely, commercial pure lac resin, commercial soft lac resin, and commercial lac wax. The methods used are the subject of Technical Paper No. 1, of the London Shellac Research Bureau ("Isolation of Pure Lac Resin").

The policy behind lac research work in the United Kingdom, namely, that, as lac is not a chemical entity, efforts have to be made to isolate its components in order to arrive at materials having the desired specific industrial properties, has borne rapid fruit. The "pure lac resin" is showing definite indications of being of higher value than ordinary lac as a varnish in electrical insulations, as the resultant film has a considerably higher breakdown voltage, higher water resistance, longer life under prolonged heating at temperatures as high as 120° C., excellent hardness, toughness, flexibility and adhesion to copper, while showing no sign of "greening" in contact with that metal.

The "soft resin," better known as the "ether-soluble resin," has been found to be directly soluble in drying oils such as linseed and tung oils and thus opens up a new field of uses for lac in the baking and stoving enamel industries. The lac wax is recoverable in an exceptionally pure state and will find scope for uses in the polishing industries, etc., and as a good alternative to beeswax.

AT a small mill operated by the Colloidal Slate Co. at Deganuy, near Conway, Wales, slates are coloured artificially by a new process. Ferric chloride is precipitated with an alkali such as ammonia, the precipitate is filter-pressed, washed until it is neutral and then peptised to make it colloidal. A colloidal condition is said to be essential to its adherence to the slate surface. Mineral pigments such as ochres, umbers, siennas, chromic oxide and manganese oxide are added to give the various colours. Slates are coated with the colouring matter, dried under gas flames and a setting agent added. About 20 different colours are made.

Micro-Organisms and Foodstuffs

Society of Chemical Industry's Symposium

A SYMPOSIUM on "Micro-organisms and Foodstuffs" was held at Manchester on December 6 under the auspices of the Manchester Section of the Society of Chemical Industry, the Food Group, and the local members of the Chemical Society. Dr. L. H. Lampitt, F.I.C., chairman of the Food Group, presided at the afternoon session, and Mr. A. McCulloch, M.Sc., A.I.C., chairman of the Manchester Section of the Society, presided at the evening session.

Recent developments in the biochemistry of moulds were the subject of a paper by Dr. P. W. Clutterbuck, F.I.C., of the London School of Hygiene and Tropical Medicine. After briefly referring to the recent capitalisation of moulds in numerous directions and to the fact that prevention of infection by moulds had become a problem of first magnitude in many industries, the author described the systematic work carried out during the last 13 years by Professor H. Raistrick and his colleagues to discover the performance and possibilities of "moulds." The position of this group of organisms in the plant kingdom, the absolute importance of using pure strains of authentic cultures, the preparation of carbon balance sheets for the metabolism of selected organisms and their use both as a biochemical classification of certain genera and as a means of selecting organisms which would repay further investigation, were referred to in turn, and, finally, some 16 slides enabled the lecturer to show that these organisms, although they were unable to synthesise their own carbohydrate from $CO_2 + H_2O$, as they were devoid of chlorophyll, yet they were able, when grown on a medium containing some source of carbon, such as glucose, together with certain inorganic salts, to synthesise compounds of almost every type known to organic chemistry.

Biochemistry of Bacteria

Discussing developments in the biochemistry of bacteria, Dr. T. K. Walker, F.I.C., of the College of Technology, University of Manchester, pointed out that biochemical investigations with bacteria in general are undertaken either for the purpose of ascertaining the intermediate and final products when a selected substrate is disintegrated, or in order to throw light on the precise mechanism by which the cell performs these operations. Into the latter category of inquiries fall those studies of enzyme action, often carried out by the methylene-blue technique, in which bacteria are used purely as catalysts. A survey was made of the extent to which Wieland's dehydrogenation hypothesis has been employed in the interpretation and co-ordination of fermentation phenomena, typical cases being quoted. The author then proceeded to discuss cases of alcoholic fermentation by bacteria, and showed how in recent years researches had demonstrated the presence of the zymase system in cells of widely different types. In this connection reference was made to the work of Neuberg and to the very recent investigations of Meyerhof and his colleagues.

Microbiology of Fruit

Dealing with the microbiology of fruit, Dr. R. G. Tomkins, M.A., of the Low Temperature Research Station, Cambridge, said that for fruit to rot three conditions were necessary: (a) the fungus must be present, (b) the fruit must be susceptible to invasion, and (c) the conditions of storage must be suitable. By way of illustration, the rotting of oranges by *P. digitatum* was considered. He observed that many fungi, some of which can cause rots, were present on the surface of the fruit, and that by increasing the number of spores present increased rotting generally resulted. *P. digitatum* could attack wounded oranges or oranges treated with acid; and the strength of acid needed to break down resistance could be used as a measure of resistance. The rate of development of rots in storage was largely determined by temperature, whilst relative humidity exerted a slight effect. Measures taken to avoid losses from rotting included those designed: (a) to reduce the number of spores present, (b) to avoid mechanical injury, (c) to increase resistance to attack, and (d) to delay the development of any rot which might begin.

The bacteriology of canned milk products was covered in a paper by Miss A. A. Nichols, B.Sc., M.S., N.D.D., of the Hannah Dairy Research Institute, Kirkhill, Ayr. The common practices in the manufacture of sweetened condensed milk, unsweetened evaporated milk, and canned cream were briefly described, since a study of the bacteriology and ultimately to a large extent the keeping quality of these products is intimately bound up with the processing methods. The technique suitable for the bacteriological examination and reinoculation of canned dairy produce was suggested. The bacteriological defects of sweetened condensed milk, unsweetened evaporated milk, and unsweetened canned cream were discussed separately, as the methods employed for preserving them are different, the first of these relying on concentrated sugar solution for the prevention of the growth of micro-organisms, and the last two on severe heat treatment. Thus the organisms discussed as responsible for faults in the two types of foodstuff show considerable differences. Attention was drawn to the fact that chemical and physico-chemical factors, as well as micro-organisms, might produce serious spoilage in canned milk products, and to the need for both bacteriological and chemical knowledge in the study of defective tins.

Experiences in the Baking Industry

A paper on micro-organisms in the baking industry was read by Mr. C. H. F. Fuller, M.Sc., A.I.C., of J. Lyons and Co., Ltd. The author pointed out that the micro-organisms associated with breadmaking could be divided into three main groups: (a) the yeast purposely added to the dough, (b) bacteria assisting the development of the gluten, and (c) unwanted organisms introduced unintentionally. Recent research had been directed to the elucidation of the changes in the flour brought about by the products of yeast metabolism, and has included a study of the yeast-toxin of flour, the effect of many yeast stimulants, the progressive changes in the dough during fermentation, and the factors governing the formation of acetyl-methyl-carbinol, which had been stated to be the predominant cause of flavour. The addition of cultures of the typical "leaven" bacteria had been suggested and also the introduction of enzymes from *Aspergillus oryzae* and the use of unfermented grape juice. A relative humidity of 90 per cent. or over was required for rapid mould growth on bread. Carbon dioxide retarded the growth of mould, and ultra-violet radiation had been employed to destroy moulds on bread. Growth of *mesentericus* might be arrested by the addition of acid substances to the dough, but strict cleanliness and complete cooling of the bread before wrapping should make this addition unnecessary.

IMPORTS of carbon black into Germany have been expanding this year and for the first nine months of 1935 the total quantity was 9,091 metric tons, thereby attaining a new peak far surpassing the same period of previous years. The comparative figure for the first nine months of 1934 was 6,072 metric tons. The increased importation of carbon black was due largely to the heavily increased motor traffic in Germany, which brought about a greater demand for automobile tyres, the largest industry consuming the pigment. Germany is still continuing with a view of developing a domestic black suitable as a substitute for American carbon black.

The Resistance to Grinding of Coals

Barnsley Soft Coal as a Standard

AN investigation to determine the fundamental principles involved in the crushing and grinding of coals and associated minerals, and to ascertain the relationship between resistance to grinding and other physical characteristics of the material, was the subject of a paper which Dr. Harold Heywood read before the Institute of Fuel on November 13.

The resistance to grinding of a coal, said Dr. Heywood, can be expressed by empirical terms which apply only to a particular machine and method of procedure, *e.g.*, for a small ball-mill as the number of revolutions required to grind to a definite percentage passing a specified sieve. Results expressed in this way may be rendered more general by using some convenient material as a standard, and expressing other values relatively to this standard value. The ratio of the experimental value to the standard value has no units, and is termed the relative or specific resistance to grinding. The difficulty of this system is to find a coal which would be universally accepted as a standard.

A more fundamental problem is that of determining an absolute value of resistance to grinding which could be used to assess the efficiency of a pulveriser in the same way that calorific value by bomb calorimeter is used to assess the efficiency of a boiler. In other words, the determination of an ideal and perfectly efficient pulverising process. For this purpose resistance to grinding must be expressed in the fundamental units of mass, time and length, and since the object of a pulverising process is to expose new surface of material, the resistance to grinding is expressed most conveniently by the number of foot pounds of energy required to produce one square foot of new surface.

Objects of Research

The objects of the research reported by Dr. Heywood were to determine the most efficient method of disintegrating coals, which could then be used as a standard to compare the relative efficiencies of industrial crushers and pulverisers; and also to investigate simplified methods of determining relative resistance to grinding to be used for routine tests on coal.

The most efficient method of disintegration was found to be the compression test on cubes of coal; crushing by impact of a falling weight and between crushing-rolls had approximately equal efficiency under certain conditions, but, in general, the efficiency of these processes decreasesd as the energy applied to the crushing process was increased. The resistance to grinding is measured by the energy in foot pounds required to produce one square foot of new surface, and has been determined for six different types of coal, two anthracites, shale and pyrites. Hardness measurements were made on the coals by means of the scratch test and by means of an abrasion test. The relative hardness determined by these two methods was approximately the same for most coals, but cannel was shown to be exceptionally tough. Unless unwarrantable assumptions are made, said Dr. Heywood, specific surface calculations are too complicated for industrial and routine testing, and sufficient accuracy for most purposes would be obtained by taking as a measure of the fineness the percentage of the product passing a specified sieve. The results of the tests were compared directly by using in each case the value for Barnsley soft coal as a standard.

Points from the Discussion

Mr. C. A. SEYLER said he had been working with the same object as Dr. Heywood, *i.e.*, the determination of the fundamental principles governing the breakage of coals. The key to the whole subject he had found in the work of Dr. Geoffrey Martin as long ago as 1923, in which experimental evidence was given of Rittinger's law that the new surface produced was directly proportional to the work expended in fracture. The method which Mr. Seyler had used was the familiar shatter test, long used for coke. The energy was supplied by the fall of the coal itself and could be measured in foot-lb., being 300 foot-lb. for each fall of 50 lb. through 6 ft. It was applicable only to large coal. If the new surface produced could be measured it could be plotted against the energy expended, as measured by the number of falls. The method was similar to Dr. Heywood's impact test. The results showed a very fair straight line over the usual four falls, and the resistance to shattering could be expressed in foot-pounds per sq. ft. of surface or in the C.G.S. units. The smallness of the results had surprised him when he had compared them with the figures given for the energy required for pulverisation in commercial mills. However, Dr. Heywood's impact experiments had given figures of the same order.

Estimation of Hardness

Particularly valuable was Dr. Heywood's comparison of the results of different methods of estimating the *hardness* of materials. It had long been felt, no doubt, that the term "hardness" included different qualities which were urgently in need of definition and of a specific terminology. For the shatter-hardness obtained in his experiments Mr. Seyler proposed the name "durity." The term "resistance to grinding" was awkward and did not well express the condition of shattering under impact or compression. The term "durity" could be defined as the minimum energy, suddenly applied, necessary to produce unit of new surface. It was indeed a measurement of the surface energy of the solid akin to the surface tension of a liquid.

The difference between brittle materials, such as coals, and substances, such as shale, in the compression and impact tests was remarkable. In the compression test the hardness of non-brittle substances was much less than in the impact test. It would appear that the key lay in the time during which the energy was applied. Many rocks would undergo a certain strain on the immediate application of the stress, and this was followed by a gradual further strain which was somewhat analogous to plastic flow except that it was not continuous but finally ceased. As a substance became less brittle, this time effect must pass into continuous flow and the substance became plastic. A similar thing must happen with coal when the temperature was raised. The energy of fracture must pass into that of thermo-plastic flow just as pitch was hard and brittle at low temperatures under sudden impact, but would flow under continued pressure, and at higher temperatures was plastic or even liquid. There was a distinct indication in figures given in the paper that so far as British coals were concerned there was a minimum of "hardness" somewhere in the region of the semi-bituminous coals, as Mr. Seyler had suggested in an address last year.

Temperature Relationship

Dr. HEYWOOD said it was not surprising that Mr. Seyler's drop shatter test figures were slightly higher than the compression test figures. They were quite close, considering the variables of the problem; but in the drop shatter test there was bound to be slight loss, due to such factors as air friction, which were not present in a compression test. It would be useful to know the relationship between temperature and resistance to grinding, because we should be able to establish the exact temperature at which it would be best to grind a coal.

Mr. W. L. BOON suggested that the manufacturer of pulverisers might be rather frightened by the amount of work which had to be done before he could appreciate how much power would be required to reduce a given quantity of

material, and he would look for some simple means. One shuddered to think of the tremendous amount of power which must be wasted in grinding commodities. Presumably the amount of power to be provided had been arrived at in a very haphazard hit-and-miss manner, in the light of experience and practice, and he imagined that there had been no work of a character approaching that of Dr. Heywood's, which would give an indication as to the size of machine required.

Dr. HEYWOOD said that the Hardgrove mill was more or less a model of the Fuller Lehigh mill. One would expect manufacturers of roll types of mills in which pulverisation was effected by crushing action to prefer the Hardgrove type of mill, and one would expect makers of ball mills to prefer the ball mill type. He had shown, by his comparison between the Hardgrove and the ball mill test, on the sieve analysis basis, that they were in good agreement; therefore he considered that either would be suitable for a manufacturer's purpose. He was told that the time required to make the Hardgrove test was about one hour, apart from the preparation of the sample, whereas the ball mill test occupied at least a day, apart from the preparation of the sample. The relative merits were being dealt with in America, where there was much experience of both types. As to efficiency of grinding, he said that, based on the compression test, the efficiency of a pulveriser was about 15 per cent. He hoped to make a test showing the effect of variation of moisture content.

Mr. PERCY G. RYDER urged that the work on surface area should be carried on, because in several industries the fineness of the products as determined by sieves was of small value, and the surface factor was of importance. He had found that an impact test gave quite good comparative results for ordinary routine work. A simple apparatus was used, consisting of a cup, a tube and a ball. When the ball had been dropped a given number of times the degree of fineness of the product was determined by the amount which would pass through a given sieve.

Dr. HEYWOOD replied that in the case of many industrial powders sieving alone was quite insufficient to enable the surface area to be calculated; therefore, sieving must be followed by sedimentation or elutriation. He had no doubt that the ball impact test referred to by Mr. Ryder gave figures sufficient for their purpose; but, in order to ensure that results were strictly comparable in impact tests, one should choose a height of drop which was such that the energy of the blow corresponded approximately to the strain energy that could be stored by the specimen, or which had some definite relationship to that strain energy, so that the efficiency would be constant.

Professor WATSON commented on the agreement in the results for the specific surface and the sieving and grinding analyses, and said there seemed to be an indication that there was a constant fracture pattern. It would be interesting to know whether it applied to coals only or to materials in general, though one could hardly expect a constant fracture pattern in materials having different crystalline structure.

Dr. HEYWOOD, dealing with the reference to constant fracture pattern, suggested that the most suitable way in which to study the problem would be by means of the particle distribution curves. He was doing a certain amount of work on that.

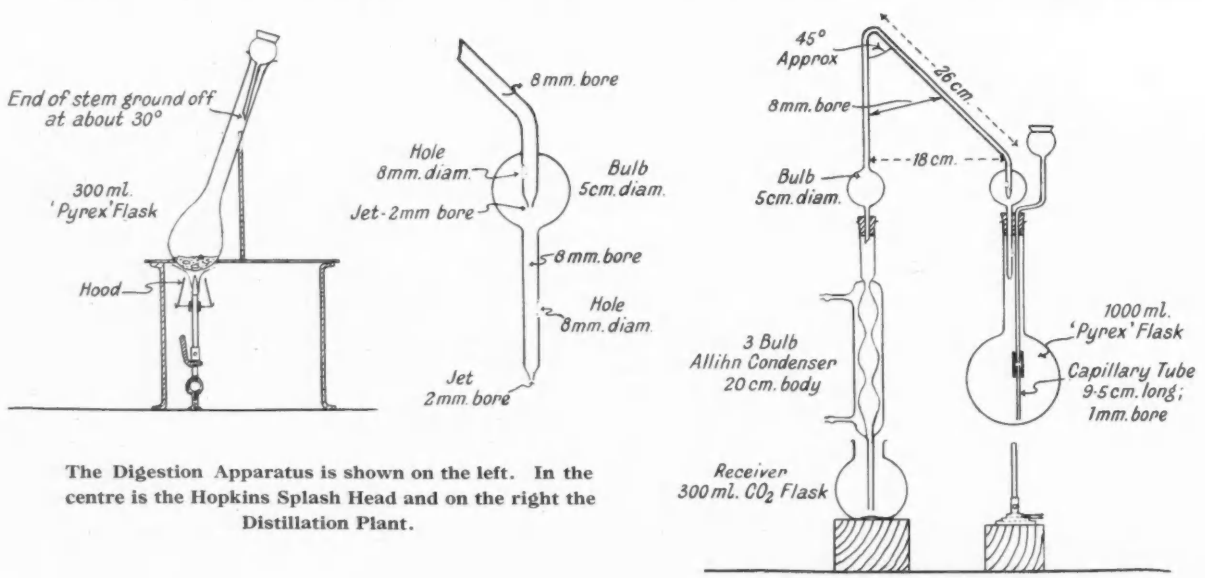
Determination of Nitrogen in Foods and Feeding Stuffs

A New Kjeldahl Method

A NEW Kjeldahl method for the determination of nitrogen in foods, feeding stuffs, leather, etc., was described by Mr. A. E. Beet and Mr. D. G. Furzey in a joint paper read before the Yorkshire Section of the Society of Chemical Industry at Hull on November 19.

One of the authors, Mr. A. E. Beet had previously described ("Fuel," 1934, *13*, 343) a modified Kjeldahl process for the determination of nitrogen in coal, in which the use of a mixed selenium-mercury catalyst gives increased speed and reliability, and it was at the suggestion of Mr. H. J. Hodsman, of Leeds University, that experiments were made on feeding stuffs and other materials mainly of interest in farming.

In the present experiments the digestion flask (300 c.c.) in each determination contained 1 grm. of flour, 10 grm. of catalyst mixture and 20 c.c. of concentrated sulphuric acid. The catalyst mixture was composed of 2 lb. of potassium sulphate, 5 oz. of mercuric sulphate (preferable to the oxide, which is liable to contain traces of nitrate), and 1 oz. of selenium. All these ingredients were finely powdered and


End of stem ground off at about 30°
300 ml. 'Pyrex' Flask
Hood
8 mm. bore
Hole 8 mm. diam.
Bulb 5 cm. diam.
Jet - 2 mm bore
8 mm. bore
Hole 8 mm. diam.
Jet 2 mm. bore
45° Approx
26 cm.
8 mm. bore
18 cm.
Bulb 5 cm. diam.
3 Bulb Allihn Condenser 20 cm. body
1000 ml. 'Pyrex' Flask
Capillary Tube 9·5 cm. long; 1 mm. bore
Receiver 300 ml. CO_2 Flask

The Digestion Apparatus is shown on the left. In the centre is the Hopkins Splash Head and on the right the Distillation Plant.

well mixed. After shaking, the contents of the flask were boiled briskly, but avoiding excessive frothing, until the liquid was a pale lemon yellow, and then for a further period of 10 minutes (the " after-boil "). The ammonia formed was then estimated by distillation.

The idea was to compare this method, both as regards speed and accuracy, with the copper sulphate method recommended in the Fertilisers and Feeding Stuffs Regulations, 1932, and used in the Department of Agriculture, Leeds University. In this, 1 grm. (or other suitable amount) of material was first heated over a low flame with 20 c.c. of pure sulphuric acid until thoroughly charred and frothing had subsided. Then, after a few minutes cooling, 10 grm. of anhydrous sodium and 0.15 grm. of hydrated copper sulphate were added and the contents boiled briskly until clear; after which an after-boil of 30 mins. is recommended but other periods were also tried.

All experiments were made in quadruplicate. In all, 13 different substances were examined in this way, involving over 700 digestions. A careful study of the complete results shows that if the after-boil is omitted the results are about 2 per cent. too low with the copper sulphate method, and 0.5 per cent. too low with the new catalyst. For many purposes such errors could be ignored. The small error in the new method is within the experimental error of a single series of results, but can be made evident by averaging the results obtained from a number of substances, after first recalculating the results so that the maximum nitrogen content found for each material is taken as 100 (see Table I).

With the new method an "after-boil" of 10 minutes suffices to reach the maximum result, whereas 30 minutes or more is needed with the copper sulphate catalyst. The increase is so slight with the new method that the after-boil is useful more as giving a margin of safety against misjudging the end of the digestion than because of increased accuracy.

Having decided on the length of after-boil needed, as above, it was decided to use this period in further series of determinations in which less material than 1 gram was taken in the case of substances rich in nitrogen. The substances analysed and the amounts taken are given in Table II. The aim was to deal in each digestion with 30 milligrams of nitrogen or slightly less, so that approximately the same weight of protein was decomposed. The amounts of acid and catalyst were as before. This method was finally adopted, and it is evident that the new method saves a half to two-thirds of the time of digestion without loss of accuracy. It has been tested on many other materials, *e.g.*, cereal foods, patent foods, meat extracts, etc., and has been found perfectly reliable.

TABLE I.

Duration of afterboil (mins.).	Nitrogen Recovered as Ammonia. Copper catalyst + 20 c.c. H_2SO_4 (mean of 13 different substances).	Selenium mercury catalyst with (a) 20 c.c. H_2SO_4 (mean of 10 different substances).	(b) 30 c.c. H_2SO_4 (mean of 8 different substances).
0	97.9	99.5	98.5
5	—	99.7	99.1
10	—	100.0	99.6
15	98.4	100.0	99.7
30	99.6	99.1	100.0

TABLE II.

Substance.	Wt. used grm.	Copper Sulphate Method Duration of heating–min. To clear	Total	N.p.c. average of 4	New Method Duration of heating–min. To clear	Total	N.p.c. average of 4
*Milk	2 c.c.	—	—	0.53	—	—	0.53
Cocksfoot grass (dry)	1.0 gm.	30	60	2.87	13	23	2.88
Eclipse swedes (dry)	1.0	30	60	1.40	12	22	1.43
Flaked maize	1.0	35	65	1.52	13	23	1.51
Indian meal	1.0	35	65	1.75	13	23	1.75
Wheat flour	1.0	32	62	1.77	13	23	1.79
Sharps	0.75	30	60	2.74	12	22	2.76
Malt culms	0.75	28	58	3.35	—	—	3.36
Bean meal	0.5	27	57	4.36	7	17	4.37
Cotton seed cake	0.5	26	56	4.32	6	16	4.40
Linseed cake	0.5	24	54	5.50	8	18	5.53
*Leather	0.4	24	54	4.99	9	19	4.98
Meat meal	0.3	25	55	7.54	7	17	7.59
Soya bean meal	0.3	26	56	7.93	6	16	7.91
Fish meal	0.25	25	55	11.44	6	16	11.43
*Hide powder (dry)	0.2	25	55	17.71	7	17	17.74

* These were not tested in the preliminary experiments.

More Notifiable Accidents

Extension of Factory Department List

THE Home Secretary has extended the provisions of the Notice of Accidents Act, 1906, requiring notice of accidents in factories and workshops to be given to an inspector, to the following classes of occurrences in a factory or workshop whether personal injury or disablement is caused or not:

Bursting of a revolving vessel, wheel, grindstone or grinding wheel moved by mechanical power; collapse or failure of a crane, or other appliance used in raising or lowering persons or goods, or the overturning of a crane; explosion or fire causing damage to the structure of any place in which persons are employed, or to any plant contained therein, resulting in suspension of work or stoppage of machinery for not less than five hours, where such explosion or fire is due to the ignition of dust, gas or vapour, or the ignition of celluloid or substances composed wholly or in part of celluloid; electrical short-circuit or failure of electrical machinery, attended by explosion or fire or causing structural damage, and involving stoppage or disuse for not less than five hours; explosion or fire affecting any room in which persons are employed and causing suspension of work for not less than twenty-four hours; explosion of a receiver or container used for the storage at a pressure greater than atmospheric pressure of any gas or gases (including air) or any liquid or solid resulting from the compression of gas.

The new order is the Dangerous Occurrences Notification Order, 1935, and comes into operation on January 1, from which date the order dated November 9, 1928, will be revoked.

Stains in Textile Materials

Mr. A. J. Hall on Methods of Treatment and Prevention

IN his contribution to a discussion on "Stains in Textile Materials" at a combined meeting of the Society of Dyers and Colourists and the Textile Institute, held at the Technical College, Leicester, on December 4, Mr. A. J. Hall, B.Sc., F.I.C., F.T.I., dealt more particularly with certain types of stains met with in the processing of cotton materials and methods which he had found satisfactory for ascertaining their nature as a means for assisting their treatment and prevention in the future.

Stains in dyed cotton fabrics, said Mr. Hall, are due to two main causes, *viz.*, (1) modification of the fibre so that it does not respond in the normal manner to processing, particularly dyeing, and (2) the presence of impurities which are of themselves stains or which modify the behaviour of the fabric in processing. In many cases simple inspection of the stain is sufficient, but in others careful examination is necessary to decide its character and origin. White patches in dyed fabric with direct dyes may be due to the presence of (a) cotton chemically modified so that it has little or no affinity for the dye, or (b) impurities which prevent access of dye to the cotton. In examination, the fabric is stripped by boiling it with dilute aqueous sodium hydrosulphite and sodium carbonate, then thoroughly washed and re-dyed with Chlorazol Sky Blue FF. If the fabric dyes level, then the stain is due to (b), but if it reappears then the cotton is modified (*e.g.*, by oxidation, acid, bacteria, etc.), and this can be confirmed by the deep brown coloration given by Harrison's reagent, a high fluidity value in cuprammonium solution, and often by a pronounced affinity for Methylene Blue.

Causes of Dark Patches

Dark patches in fabric dyed with direct dyes may be due to (a) caustic soda splashes, (b) rubbing of the fabric surface, or (c) the presence of an impurity having a strong affinity for the dye. In examination, the fabric is stripped and re-dyed as for (1). If the stain is removed then (c) is likely, whereas it will reappear if due to (a) or (b). Rubbing of the fabric surface may be ascertained by visual examination under a moderate magnification, and (a) may be identified by testing for mercerised or swollen cotton (appearance under the microscope and an increased reactivity towards various reagents, *e.g.*, conc. sulphuric acid).

Dye stains on cotton in dyed cotton-acetate rayon fabric are usually due to the presence of an oil stain in the cotton which has the property of absorbing cellulose acetate dyes. In examination, the oil can be detected by its fluorescence under ultra-violet light and by its solubility and removal by an organic solvent, *e.g.*, ether or acetone.

Black lead and black oil stains are frequently found in cotton lace materials and black oil stains in cotton woven fabrics; they arise from lubrication of the manufacturing machinery. Both types of stain are recognisable by simple inspection and can be removed only by rubbing with a detergent (*e.g.*, soap) liquor.

Marking Off of Coloured Yarns

Marking off of coloured yarns is due to the use of loose coloured yarns or to unsuitable processing. It is not always advantageous to have fast vat dyed yarns present in such goods since any marking off which occurs is then difficult to remove. An instance was cited in which cleaner results were obtained with indigo dyed borders (in white cotton fabric) than with similar borders woven with yarn dyed with a Caledon blue vat dye. The marking-off which was produced by kiering could be completely discharged by after-chemicking with indigo but not with the Caledon vat dye.

Stains met with in the processing of artificial silk were discussed by Mr. Thos. H. Jones, who pointed out that these stains may be of an oil, metal or floor dirt nature. Oil stains, when fresh, and if a suitably compounded knitting oil has been used, are usually fairly easily removed in the normal scouring operation and a suitable alkali; with perhaps the addition of an oil solvent or dispersant, but trouble may arise when goods are allowed to lie in an oily state for prolonged periods, or in certain abnormal conditions of temperature, giving rise to the so-called oxidised oils, and the brown colour associated with the oxidation. These are extremely difficult, and in some cases impossible to remove without grave risk of damage to the material.

Many of the colours used in the dyeing of acetate silk are soluble in mineral oils, and this property leads to excessive staining of the viscose due to the presence on that fibre of mineral oils that have not been, or cannot be, entirely removed. This fault may obviously be either local or general. Needle marks (swarf) may be included under the general heading of oil stains and constitute a real difficulty. In my experience, no general treatment of manufactured artificial silk goods is effective in entirely removing the black stains which remain after the oil is removed and local gentle friction is necessary in the majority of cases.

Metal stains are introduced from either the needle marks already mentioned, condensed moisture on the machines, or metal parts of the building, or from lubricating oil splashing from the running machines or shafting. The gravest risk arises when the goods are intended for the bleaching process, as any metal (copper and iron particularly) present acts as a catalyst, and rapidly brings about over oxidation, and consequent disintegration of the fibre.

White Pigments and Oil Pastes

New British Standard Specifications

THE British Standards Institution has for some time been engaged in a review of the existing British Standard Specifications for paints and paint materials and the issue of two publications, one entitled "White Pigments" and the other "White Oil Pastes," represents the first of the revisions.

In response to representations that have been made, a system of grouping the specifications has now been adopted and the publication for white pigments includes the revised form of the following specifications which were originally published separately: No. 239, Genuine White Lead; No. 254, Zinc Oxide; No. 296, Lithopone; No. 338, Antimony Oxide; No. 392, White Titanium Dioxide. To these have been added two new specifications, one for titanium white and the other for basic sulphate of lead. It will therefore be seen that the new publication includes all the British Standard Specifications for white pigments and in the grouped form should prove most useful and serviceable to industry, as well as effecting an economy seeing that it now includes seven specifications.

The publication for white oil pastes includes the revised form of the following specifications: No. 241, Genuine White Lead Oil Paste; No. 273, Zinc Oxide Oil Pastes; No. 297, Lithopone Oil Paste. This publication accordingly provides for all the white pigment oil pastes.

The opportunity has been taken to review and bring up to date the requirements of clauses in all the original specifications and also the methods of test which are detailed in the appendices. The group specifications are available as follows: No. 239-1935, White Pigments for Paints (price 3s. 8d. post free); No. 241-1935, White Oil Pastes for Paints (price 2s. 2d. post free); from the Publications Department, British Standards Institution, 28 Victoria Street, London, S.W.1.

Hydrogen Production by the Badische Process—V.

Removal of Carbon Dioxide and Sulphur

In continuation of notes on the Economics of the Synthetic Manufacture of Ammonia, published in "The Chemical Age," October 5 to November 16 inclusive, the present series deal particularly with the design of the plant for the production of hydrogen by the Badische Process.

CONSIDER a gas containing 31 per cent. CO_2 under the following partial pressures and at 20° C. :—

2.5 atmospheres, total pressure of gas would be 8.06 atm.
7.5 " " " " " " " 24.2 "
10 " " " " " " " 32.2 "
15 " " " " " " " 48.4 "

The volumes of gas at 20° C. can be taken at any figure for the purposes of this comparison; choose our own quantity, *viz.*, 11,300 cu. ft. per minute.

(*a*) *Power for Compression.*

Power required to compress 11,300 cu. ft. per minute to 8.06 *atm.*

R = Ratio of pressure, final and initial.

$R = \sqrt[n]{R_1 R_1} = 8.06$ n = 2 stages.

R = 2.84.

H.P. at 90% efficiency = 87.2* × 2 = 174.4 H.P. per 1,000 cu. ft. per minute.

174.4 × 11.3 = 1,970 h.p.

Power to 24.2 *atm.*

$R_1 = 24.2$ n = 3 stages.

$R = \sqrt{324.2} = 2.89$ $\qquad \frac{3/1.389}{.461} = 2.89$

H.P. at 90% efficiency = 88.8* × 3 = 266 h.p. per 1,000 cu. ft./min.

Therefore, 266 × 11.3=3,000 h.p.

Power to 32.2 *atm.*

$R_1 = 32.2$ n = 3 stages.

$R = 3\sqrt{32.2} = 3.18$ $\qquad \frac{3/1.508}{.503} = 3.18$

H.P. at 90% efficiency = 98.1* × 3 = 294.3 h.p. per 1,000 cu. ft. per minute.

Therefore, 294 × 11.3 = 3,320 h.p.

Power to 48.4 *atm.*

$R_1 = 48.4$ n = 3

$R = 3\sqrt{48.4} = 3.64$ $\qquad \frac{3/1.685}{.561} = 3.64.$

H.P. at 90% efficiency = 111.7* × 3 = 335.1 h.p. per 1,000 cu. ft. per minute.

Therefore, 335 × 11.3 = 3,780 h.p.

(*b*) *Quantity of Water.*

Quantity of water required theoretically to remove CO_2 = 1 cu. ft. of water at 2.5 atm. partial pressure removes (2.5 × 0.878) = 2.22 cu. ft. of free CO_2, less 2.5 per cent.

i.e. 2.15 cu. ft of CO_2 at 0° C.
= 2.31 cu. ft. of CO_2 at 20° C.

* These figures taken from a table are for air compressors, but tne power required for a mixture of CO_2 and hydrogen may be slightly different. The effect of the hydrogen would be opposite to that of the CO_2 and so it is not likely the figures will be far out from this cause; the ratio of the specific heats for Hydrogen are 1.410; for air are 1.401; for CO_2 are 1.300.

Therefore (11,300), 0.31 = 3,500 cu. ft. are removed by

$\frac{3,500}{2.31}$ = 1,515 cu. ft. = 9.450 gal. per min.

1 cu. ft. of water at 7.5 atm. partial pressure of CO_2 removes
(7.5 × 0.878) = 6.6 cu. ft. of free CO_2 less about 8%.
i.e., 6.1 cu. ft. of CO_2 at 0° C. = 6.45 cu. ft. at 20° C

Therefore, 3,500 cu. ft. by $\frac{3,500}{6.45} \times 6.25$ = 3,390 gal. per min.

1 cu. ft. of water at 10 atm. partial pressure removes
(10 × 0.878) = 8.78 cu. ft. of free CO_2 less 11.1%.
i.e., 7.8 cu. ft. at 0° C. = 8.36 cu. ft. at 20° C.

Therefore, 3,500 cu. ft. by $\frac{3,500}{8.36} \times 6.25$ = 2,620 gal. per min.

1 cu. ft. of water at 15 atm. partial pressure removes
(15 × 0.878) = 13.16 cu. ft. of free CO_2 less (say) 17%.
i.e., 10.93 cu. ft. at 0° C. = 11.8 cu. ft. at 20° C.

Therefore, $\frac{3,500}{11.8} \times 6.25$ = 1,850 gal. per min.

An allowance of 20 per cent. excess will be made in each case, so that :—

Partial Pressure CO_2	Quantity of water in gal. per min.
2.5 atmospheres	9,450 + 1,890 = 11,340
7.5 "	3,390 + 678 = 4,070
10 "	2,620 + 524 = 3,140
15 "	1,850 + 370 = 2,220

(*c*) *Power Required to Pump Water.*

The water has to be pumped in against the pressure of the gas in the scrubbers and the resistance to flow (which will be small enough to neglect in this comparison).

The pressure in the first case is 8.06 atm., therefore

$Power = \frac{8.06 \times 2,120 \times 11,340}{33,000 \times 6.25}$ = 940 h.p. or at 60% efficiency = 1,565 h.p.

In the second case at 24.2 atm., therefore

$Power = \frac{24.2 \times 2,120 \times 4,070}{33,000 \times 6.25}$ = 1,010 h.p. or at 60% efficiency = 1,680 h.p.

In the third case at 32.2 atm., therefore

$Power = \frac{32.2 \times 2,120 \times 3,140}{33,000 \times 6.25}$ = 1,030 h.p. or at 60% efficiency = 1,720 h.p.

In the fourth case at 48.4 atm., therefore

$Power = \frac{48.4 \times 2,120 \times 2,220}{33,000 \times 6.25}$ = 1,100 h.p. or at 60% efficiency = 1,830 h.p.

(*d*) *Hydrogen Removed.*

It is obviously important that the percentage of hydrogen removed by solution along with the CO_2 should be as low as possible. In practice, we have been informed that the percentage loss is between 10 and 15 per cent. As will be seen, it does not appear possible that such loss can be due to the solution of the hydrogen, it is much more likely that it is due to leakage during compression, at joints, or as small bubbles carried along with the solution leaving the scrubber. It would be important, therefore, to minimise the losses in these directions as far as possible. Arrangement should be made in the scrubbing system to allow the entrained gas to escape from the water while still at the high pressure.

No reference can be found as to the validity of Henry's or Dalton's laws of solubility of gases under high pressure in connection with the permanent gases. A few notes have been included in this report but nothing seems to have been published for pressures above 3 atmospheres, which pressure was the highest investigated by Henry in 1803. There seems no reason to expect with hydrogen any but a very slight departure from Henry's law as the pressure increases. Such departure would be much less than with CO_2 which already commenced to show a slight departure at 3 atmospheres, but which even at 10 atmospheres does not amount to a very serious difference in the solubility coefficient; at any rate, not sufficient to account for a 10 per cent. loss of hydrogen in the scrubbing if the hydrogen were to show a similar difference with increase of pressure as the CO_2. Neither can the effect be ascribed to a greater solubility of the hydrogen in H_2CO_3 aq. for the presence of salts and of acids in all cases investigated decreases the solubility of the hydrogen, *e.g.*

Geffcken, experimenting at 25° C., obtains following values :—

Gram. Eqt. Acid per litre.	HCl	HNO_3	CH_3COOH
0.0	0.0193	0.0192	0.0193
0.5	0.0186	0.0188	0.0192
1.0	0.0179	0.0183	0.0191
2.0	0.0168	0.0174	0.0188

The solubility of hydrogen @ 0° C. and 760 mm. in water

(pure) at 20° C. is 0.0177 (it has a minimum solubility of 0.0144 at 60° C.).

The percentage of hydrogen in the gas considered is 61.5 per cent., therefore

at 8.06 atm. the partial pressure would be 4.96 atm.
" 24.2 " " " " " " 14.9 "
" 32.2 " " " " " " 19.8 "
" 48.4 " " " " " " 29.8 "

The *percentage removal* will be obtained as follows:—

(1) 4.96 × 0.0177 cu. ft. @ 0° C. are removed by 1 cu. ft. of water @ 20° C., when saturated, therefore

$$11{,}340 \text{ gal. remove } \frac{4.96 \times 0.0177 \times 11{,}340}{6.25} = 159 \text{ cu. ft.}$$

There are $(0.615 \times 11{,}300 \times \frac{293}{273}) = 7{,}450$ cu. ft. of H_2 passing per minute,

Therefore, removal of Hydrogen during scrubbing = 2.13%.

(2) In the second case:—

$$\frac{14.9 \times 0.0177 \times 4{,}070}{6.25} \times \frac{100}{7{,}450} = 2.30\%.$$

(3) In the third case:—

$$\frac{19.8 \times 0.0177 \times 3{,}140}{6.25} \times \frac{100}{7{,}450} = 2.36\%$$

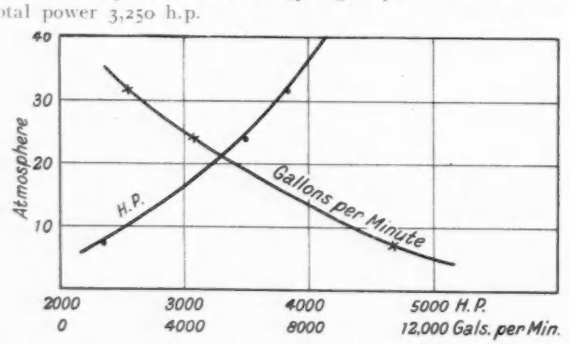
(4) In the fourth case:—

$$\frac{29.8 \times 0.0177 \times 2{,}220}{6.25} \quad \frac{100}{7{,}450}$$

Therefore the removal of hydrogen which (theoretically) would occur would not amount to much in any of these cases and there is little difference, the amount of water decreasing as the pressure increases. The comparison may be summarised as follows:—

Total pressure.	Power for Compression H.P.	Power for purifying H.P.	Allowing 70% recovery.	Total Power.	Gal. water per min.	% Loss of H_2.
80.6	1,970	1,565	470	2,440	11,340	2.13
24.2	3,000	1,680	504	3,504	4,070	2.30
32.2	3,320	1,720	515	3,835	3,140	2.36
48.4	3,780	1,830	550	4,330	2,220	2.51

It is fairly clear from the above table that the economic pressure to work at lies somewhere between 10 and 25 atmospheres. From the following graphs it appears that 20 atmospheres is the best pressure to budget for. At this point the water required would be 4,500 gal. per minute and the total power 3,250 h.p.



There is one other point to be considered, *viz.*, whether it is desirable to wash by stages; that is, remove some of the CO_2 at low pressure and so reduce the quantity of gas which has to be taken to the higher pressure.

Suppose 10 per cent. of the CO_2 to be removed at 8 atm. (total pressure) and the remainder at 24 atmospheres pressure:

Stage I.—To remove the 20 per cent of the CO_2 would require about two-thirds of the water given in the table, *viz.*, 7,560 gal.

To compress the gas would require (in two stages) 1,970 h.p., while to pump the water would require about 314 h.p.

Stage II.—To compress $11{,}300 - \frac{3}{4} \times 3{,}500 = 11{,}300 - 2{,}340 = 8{,}960$ cu. ft. from 8 to 24 atm. would require (in one stage) @ 90 per cent. efficiency, 92.3 h.p. per 1,000 cu. ft. per minute, *i.e.*, 827 h.p.

The CO_2 will be $\frac{1{,}170}{8{,}960} \times 100 = 13$ per cent. of the total gas, so that the partial pressure would be $0.13 \times 24 = 3.1$ and the CO_2 removed per cubic feet of water will be

$$3.1 \times 0.878 = 2.72 \text{ less } 3\%$$
$$= 2.64 \text{ @ } 0°\text{C.}$$
$$= 2.8 \text{ ft. 3 @ } 20°\text{C.}$$

Therefore, to remove 1,170 cu. ft. requires $418 \times 6.25 = 2{,}600$ gal. per minute.

The power required to pump this water would be

$$\frac{24.2 \times 2{,}120 \times 2{,}600}{33{,}000 \times 6.25} = 650 \text{ h.p.}$$

which at 60 per cent. efficiency = 1,080 h.p., and recovery 70 per cent. = 324 h.p.

The total power would therefore be

$$(1970 + 314) + (324 + 827) = 3{,}435 \text{ h.p.}$$

And the *water* would be about

$$7560 + 2600 = 10{,}160 \text{ gal.}$$

Even if other pressures are considered, there appears to be no economy to be obtained by carrying out the washing in several stages.

It is interesting to note that solvents such as acetone, methyl ethyl ketone or methyl alcohol, dissolve CO_2 much more readily than water, at the same temperatures. The volume of acetone (which is the best solvent) required would be about

$$\frac{3{,}500}{6.3 \times 2.5} = 223 \text{ cu. ft.} = 1{,}400 \text{ gal. per minute}$$

allowing 20 per cent. excess, 1,680 gal. per minute.

The *power* for compression of the liquor to 8 atm. would be about 72 h.p. The power for compression of the gas would be 2,000 h.p. The number of scrubbers would be one-third; the power would be a little more than half for the water washing. The difficulty of obtaining the large quantities, of such solvents and the inevitable losses, however, offer more serious difficulties than the advantages to be gained.

Coconut Palm Products

An Exhibition Opened in London

AN exhibition devoted to the utilisation of the coconut palm, from which as many as two hundred products are obtained, was opened at Ceylon House, Aldwych, London, W.C.2, on December 9.

The kernel of the coconut is the main commercial product, and is marketed in three forms. First as the coconut of commerce; secondly as copra, or the kernel of the nut dried either by sun or artificial heat; thirdly as dessicated coconut, which is prepared mainly in Ceylon to the yearly output of 32,450 tons (1934). Each ton of copra represents the product of 6,000 to 7,000 nuts. Powerful expressing machinery extracts from it coconut oil and poonac or coconut cake. Coconut oil is used for soap and candles and, to a larger extent, for the manufacture of margarine; it is also employed in the preparation of cosmetics and medicinally. The poonac finds use as a cattle and poultry food.

The water contained within the immature nut makes a cooling beverage, greatly valued for its vitamin contents. A creamy milk is made from the kernel of the coconut by grating, slightly moistening and then squeezing the mass: this milk is an essential ingredient in the preparation of curry, which accompanies the daily meal of boiled rice. Toddy is the sweet juice obtained from the fruit-spathe; when fermented it is distilled to yield a spirit, arrack, the local equivalent of gin and whisky. From toddy, by suitable methods, can also be made a material known as "jaggery," resembling maple sugar.

The shell of the nut is exported to Europe in certain quantities for turning into charcoal, which is employed for purifying wines and as a filling for gas mask canisters.

A New Method of Temperature Control

Use of Vacuum Switchgear

THE recent introduction of the Sun-Vic thermally-operated vacuum switch makes possible a completely new outlook on the subject of relay control in general, and temperature control in particular. The switch (Fig. 1), which is sealed in vacuum in a glass envelope measuring $4\frac{1}{4}$ in. × $\frac{7}{8}$ in., controls 2 k.w. at 250 volts A.C. or D.C., or 2.75 k.w. at 440 volts A.C. or D.C.; larger sizes, up to 9 k.w. at 440 volts, are also made. The operation is obtained by the expansion of a small heating grid requiring less than 2 watts.

The vacuum operation itself confers many advantages, such as small size, light moving parts, entire absence of arcing, and therefore of radio interference, and complete protection

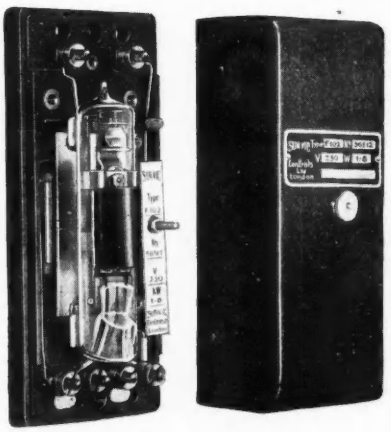


Fig. 1.—A Typical Vacuum Switch with cover removed.

against contamination by chemical fumes or moisture. These properties combine to give the switch indefinite life, and no sign of deterioration can be seen after several million makes and breaks. The fact that it is thermally and not electro-magnetically operated confers a whole series of additional advantages, especially in its application to light contact instruments, and thermal controls in particular. The operation by thermal expansion eliminates slap, and the control circuit being non-inductive reduces to a negligible degree

Type 1. Fixed temperature Thermostat. 100 watts.

Type 2. Fixed temperature Thermostat. 200 watts.

Fig. 2.—Vacuum Thermostats.

arcing at make and break of the control, whether it be a toluol regulator, a dial thermometer, or similar contact instrument. The inherent time lag of from 1 to 10 seconds eliminates hunting or chatter in the control, and the small contact separation of the switch permits operation on a frequent time cycle, and therefore a closer differential is obtainable. The switch operates on A.C. or D.C. without modification to the control circuit, and, furthermore, the need for a special low voltage control circuit is eliminated, since arcing is eliminated at the instrument contacts, even at normal supply voltages.

A parallel development to the vacuum switch is the vacuum thermostat (Fig. 2). This is a small bimetal device, sealed into a glass tube measuring approximately $2\frac{1}{2}$ in. long × $\frac{1}{2}$ in. diameter. The thermostat is set in manufacture to the required operating temperature, and cannot alter since no burning or arcing of the contacts can take place, and dust, moisture or other foreign matter are completely excluded. The totally sealed construction also enables the thermostat to be immersed in water, or other fluid, or to be operated in corrosive or inflammable atmospheres. The thermostat

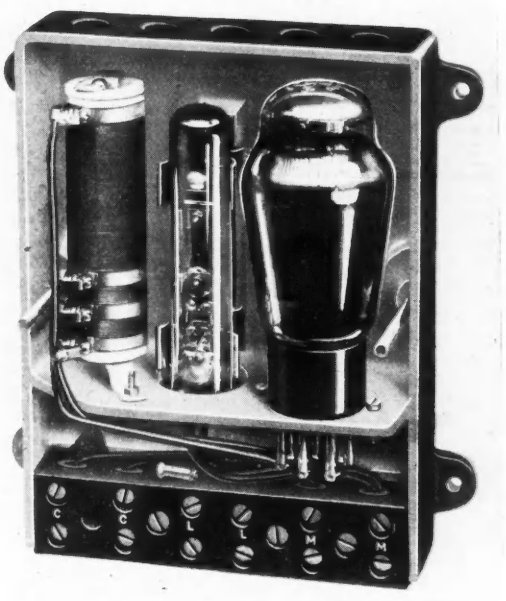


Fig. 3.—Thermionic Valve Relay.

may have any setting between 0° C. and 200° C. and controls up to 1 amp. at any voltage up to 250 A.C. or D.C. Typical applications within this power limit include the control of wax, oil or water baths, developer tanks, oil filters and viscometers, thermocouple cold-junction controls, and similar apparatus.

For the control of large amounts of power up to 9 k.w. at 440 volts A.C. or D.C. the thermostat is used to control the relay circuit of the vacuum switch. Typical examples in this field are the control of plastic moulding processes, water heaters, drying chambers, and air temperatures in general, and other similar applications. The small vacuum thermostat, however, has a useful field as a temperature alarm. Set for a predetermined temperature it can be used to light a lamp or ring an alarm bell at the danger temperature.

Thermionic Valve Relay

Where a highly sensitive control operating to 1/100° C. is required, the valve relay shown in Fig. 3 may be used. This relay comprises a 2 k.w. or 3 k.w. vacuum switch, which derives its control current from the plate circuit of a pentode valve. The grid circuit of the valve requires only 2-3 micro-amperes for its control, and in operation with a suitable mercury-in-glass contact thermometer all troubles due to sublimation or oxidisation of the mercury surface are eliminated, and the temperature setting remains constant indefinitely.

These and other similar controls depending on vacuum switchgear for their operation are new developments of Sun-Vic Controls, Ltd.

British Overseas Chemical Trade in November

Exports and Imports Increase

ACCORDING to the Board of Trade returns for the month ended November 30, exports of chemicals, drugs, dyes and colours were valued at £1,869,979, as compared with £1,779,176 for November, 1934, an increase of £90,803. Imports were valued at £1,076,272, as compared with £173,960. Re-exports were valued at £44,388.

Imports

	Quantities. November., 1934.	Quantities. November., 1935.	Value. November, 1934. £	Value. November, 1935. £
Acids—				
Acetic .. .. cwt.	13,623	14,776	21,806	19,772
Boric (boracic) .. ,,	4,021	2,280	3,922	2,478
Citric .. .. ,,	3,769	1,210	10,994	4,813
Tartaric .. .. ,,	1,869	3,580	8,207	14,614
All other sorts .. value	—	—	10,111	11,166
Borax .. .. cwt.	26,136	11,398	13,022	7,909
Calcium carbide .. ,,	76,898	111,160	43,612	64,730
Phosphorus .. ,,	1,448	1,444	4,673	3,907
Potassium compounds—				
Caustic and lyes ,,	15,866	10,759	20,356	12,550
Chloride (muriate) ,,	36,130	86,680	11,540	26,536
Kainite and other mineral fertiliser salts cwt.	112,970	120,651	15,802	19,198
Nitrate (saltpetre) ,,	5,300	4,024	4,527	3,852
Sulphate .. .. ,,	25,885	22,082	9,147	8,985
All other compounds ,,	11,902	9,511	20,270	13,794
Sodium compounds—				
Carbonate, including crystals, ash and bicarbonate .. cwt.	25,403	15	7,560	8
Chromate and bichromate .. .. cwt.	2,074	638	2,777	1,057
Cyanide .. .. ,,	940	3,819	1,887	9,431
Nitrate .. .. ,,	40,080	500	7,793	110
All other compounds ,,	23,217	29,276	15,344	29,392
Other chemical manufactures .. .. value	—	—	212,210	265,437
Drugs, medicines and medicinal preparations—				
Quinine and quinine salts .. .. oz.	62,881	166,623	5,292	13,680
Medicinal oils .. cwt.	3,030	4,481	9,958	14,229
Ointments and liniments cwt.	14	26	660	1,188
Proprietary medicines value	—	—	64,021	60,221
All other sorts, manufactured or prepared			44,829	44,744
Bark Cinchona (bark Peruvian, etc.) cwt.	1,518	1,344	6,849	8,762
All other sorts, raw or simply prepared value	—	—	33,198	69,265
Dyes and dyestuffs—				
Finished dyestuffs (coal tar) .. .. cwt.	3,653	4,972	97,541	137,862
Extracts for dyeing ,,	4,482	4,305	11,209	10,970
Chestnut extract .. ,,	22,514	43,867	15,500	30,610
Quebracho extract ,,	43,163	14,678	24,504	11,975
Other extracts for tanning cwt.	15,374	27,777	10,690	18,826
All other dyes and dyestuffs .. .. cwt.	929	721	12,711	15,534
Painters' colours and materials—				
White lead (basic carbonate) .. cwt.	7,279	7,151	8,610	9,427
Lithopone .. ,,	18,905	17,088	12,938	11,127
Ochres and earth colours cwt.	22,611	34,536	8,985	11,516
Bronze powders ,,	1,832	2,260	11,326	15,488
Carbon blacks .. ,,	25,655	23,792	36,788	36,152
Other pigments and extenders, dry .. cwt.	25,712	36,411	8,647	9,361
All other descriptions ,,	16,728	15,005	32,496	25,596
Total .. .. value	—	—	902,312	1,076,272

Exports

	Quantities. November., 1934.	Quantities. November., 1935.	Value. November, 1934. £	Value. November, 1935. £
Acids—				
Citric .. .. cwt.	3,554	3,836	12,266	17,166
All other sorts .. value	—	—	21,161	29,081
Aluminium compounds tons	3,094	2,199	30,781	16,637
Ammonium compounds—				
Sulphate .. ,,	16,901	16,082	96,456	94,450
All other sorts .. ,,	2,654	1,687	30,617	22,886
Bleaching powder (chloride of lime) .. .. cwt.	80,179	81,175	20,169	21,660
Coal tar products—				
Cresylic acid .. gal.	141,230	208,646	13,183	17,412
Tar oil, creosote oil, anthracene oil, etc. ,,	1,969,484	1,241,248	37,896	31,716
All other sorts .. value	—	—	21,123	17,989
Copper, sulphate of tons	1,591	1,737	21,276	25,181
Disinfectants, insecticides, etc. .. .. cwt.	36,998	31,173	81,397	67,549
Glycerine .. .. ,,	17,121	9,350	40,658	23,142
Lead compounds .. ,,	15,152	15,310	17,794	19,416
Magnesium compounds tons	464	571	12,844	14,229
Potassium compounds cwt.	7,632	6,984	13,437	14,458
Salt (sodium chloride) tons	30,447	28,996	67,473	63,459
Sodium compounds—				
Carbonate, including crystals, ash and bicarbonate .. cwt.	259,882	383,275	69,294	89,699
Caustic .. .. ,,	213,801	256,905	117,102	125,738
Nitrate .. .. ,,	20,353	19,194	7,141	6,316
Sulphate, including saltcake .. .. cwt.	93,884	74,286	8,793	6,373
All other sorts .. ,,	68,642	82,884	81,214	88,052
Zinc oxide .. .. tons	1,441	1,555	26,973	28,158
All other descriptions value	—	—	250,215	269,173
Drugs, medicines and medicinal preparations—				
Quinine and quinine salts .. .. oz.	77,340	167,681	9,668	18,404
Proprietary medicines value	—	—	106,787	112,212
All other descriptions ,,	—	—	145,329	152,348
Dyes and dyestuffs—				
Alizarine, alizarine red and indigo (synthetic) cwt.	713	2,510	4,236	17,384
Other finished dyestuffs (coal tar) .. cwt.	7,161	9,827	103,042	134,109
All other descriptions ,,	29,287	21,130	33,331	30,284
Painters' colours and materials—				
Ochres and earth colours cwt.	12,753	17,313	12,609	17,616
Other pigments and extenders, dry .. cwt.	29,342	30,470	37,136	46,349
White lead .. ,,	5,795	6,047	10,733	12,937
Paints and painters' enamels, prepared cwt.	38,127	38,952	102,387	103,030
Varnish and lacquer gal.	89,039	75,905	33,177	29,383
All other descriptions cwt.	39,977	43,536	81,478	85,983
Total .. .. value	—	—	1,779,176	1,869,979

Re-Exports

	Quantities. November., 1934.	Quantities. November., 1935.	Value. November, 1934. £	Value. November, 1935. £
Chemical manufactures and products .. value	—	—	16,665	15,693
Drugs, medicines and medicinal preparations—				
Manufactured or prepared .. .. value	—	—	9,761	11,650
Raw or simply prepared value	—	—	13,831	1713,5
Dyes and dyestuffs and extracts for dyeing and tanning .. .. cwt.	430	934	877	2,359
Painters' colours and materials .. .. cwt.	606	566	801	1,169
Total .. .. value	—	—	41,935	41,388

Sir John Cadman's Views on Oil from Coal

The Annual Chemical Dinner

SPEECHES were, as usual, reduced to a minimum, both in number and length, at the Annual Chemical Dinner held at the Wharncliffe Rooms, Great Central Hotel, London, on Tuesday. Sir John Cadman, chairman of the Anglo-Iranian Oil Co., Ltd., and president of the Institution of Petroleum Technologists, presided over an assembly of about five hundred, representing all the societies under whose auspices the dinner is held. Amongst the presidents of the various organisations in attendance were Professor J. F. Thorpe (Institute of Chemistry), Professor A. G. Green (Society of Dyers and Colourists), Mr. W. A. S. Calder (Society of Chemical Industry), Dr. Herbert Levinstein (Institution of Chemical Engineers) and Mr. J. F. Ronca (Chemical Club). Other societies represented were the Chemical Society, the Society of Public Analysts, the Faraday Society, the Biochemical Society, the Oil and Colour Chemists Association, the British Association of Chemists, and the Association of British Chemical Manufacturers. Apart from the loyal toasts there were only two brief speeches, the submission of, and the response to, the toast of "Chemistry."

The Search for Utopia

Sir FRANK SMITH, secretary of the Department of Scientific and Industrial Research, in proposing the toast, said the object of the chemist was to reach Utopia. Although he never succeeded he discovered a number of other things, and it was those other things that had given us the great chemical industry as we knew it in this country to-day. The discoveries of the chemist had given us rayon, petrol from coal, and innumerable other things, and they had given to the medical world, if not the elixirs of life, at least many invaluable blessings. But they must remember that the chemist to-day was still a very ignorant sort of individual, though he qualified that remark by adding that the larger the circle of light the greater was the darkness beyond it. The oil in which their chairman was interested was really derived from the energy of the sun; the same was true of the coal supplies of this country and of the flowers on the table before him; they were all derived from the energy of the sun acting in a particular chemical fashion on their ingredients. The chemist in his artful fashion explained the action as photo-synthesis. He did not know what it was, but that was a word to hide his ignorance. Chemistry was in the same position as most of the applied sciences to-day. There were lots of people who said we were going to pieces, but it must be remembered that there always had been such people.

The Need for Co-operation

Sir JOHN CADMAN, in responding, said he was interested in the effort that was being made to bring together all the societies represented at the dinner. It was highly desirable that they should work together for the purpose of being housed in a single building. Such a movement would have an important effect upon the industries for which they catered and he hoped that as a result of that development they would rope in other scientific bodies. In the end they might find that they had been the means of erecting or constructing a great building in which not only the chemical groups might be housed but in which they might be linked with other scientific societies. He firmly believed that if such a policy were pursued the work they were doing would be of lasting benefit, not only to the chemical industry of this country but to the country as a whole.

A great deal of interest had been taken in the production of oil from coal, and one hardly picked up a newspaper without reading that someone had discovered another new method. People failed to appreciate that the oil with which some of those present were dealing came up out of the earth through a pipe and that when they had reckoned the cost of drilling the hole it was difficult to put a price on the oil. When it came to dealing with coal, the raw material had first to be dug out of the earth, and at the pit-head it cost from 10s. to £1 per ton. Every time they applied chemical action to the coal they were adding to the cost of the final product, which ultimately had to compete with the oil which came through the pipe. We were all very national in our feelings and we would all wish to see, for instance, our nation supplied with oil in this country. Therefore we were all enthusiastic when we were told of the possibilities of making petrol from coal, but there was a financial aspect which must not be forgotten. The present imports of oil into this country were giving to the national revenue some 30 to 40 million pounds a year, and if the whole of those imports were discontinued the loss of revenue would have to be made good in some other way. That was where the great chemical industry came into the picture. It was for them to go deeply into the problem and see whether the costs could be brought down. Possibly a solution might ultimately be found.

This concluded the speechmaking and the remainder of a very pleasant evening was devoted to dancing.

Commercial Travellers' Schools

Annual Festival Appeal Yields £14,380

THE 90th anniversary festival of the Royal Commercial Travellers' Schools (Pinner) was held on December 13 in the Hall of the Worshipful Company of Drapers, Throgmorton Street, London. Sir Ernest J. P. Benn, C.B.E., the appeal president, presided. During the evening it was announced that this year's appeal effort had resulted in a total of £14,380. The president's list amounted to £5,604.

Sir WILLIAM RAY, M.P., proposing the toast of the schools, said it was good to know that the schools were supported entirely by voluntary effort. There was a danger that, with the spread of the State doctrine, the well of charity would dry up. Still, individuality always came into its own. There would be no British Empire if they had not relied upon individuals.

Sir ERNEST BENN, responding, said he had never been able to surmount a feeling of suspicion of anything that happened in the last 20 years, and when he knew that anything was 90 years old he felt that on those grounds alone it must be good. That institution was celebrating its 90th anniversary festival. It had a glorious record. "I go back in thought to the Commercial Travellers' Schools a good many years," continued Sir Ernest, "because I am and have been for the last 46 years a commercial traveller. That, I claim, is my job." Speaking of what he had seen at the schools, Sir Ernest said the atmosphere at Pinner was a sheer delight; it was the atmosphere of work, endeavour, discipline and order, but, much more, it was the atmosphere of the good life. The excess of expenditure over income in the last five years was £8,742, and for the first time in their history the board had had to resort to the assistance of a bank overdraft. He felt sure that in the coming year, under their new president of appeal, they would see that the overdraft was removed before the inevitable rise in the bank rate.

Mr. CLARENCE E. BARTHOLOMEW, who is to be the next appeal president, proposed the toast of "The Ladies, Stewards and Visitors," to which Mr. Rudolf Moritz, K.C., and Mr. Stanley E. Smith responded. The latter, in eight years as a steward, has collected £10,292 for the schools.

Mr. E. BURRELL BAGGALLAY (president of the schools and chairman of the board of management), in proposing the toast of "The Festival President," said they were deeply impressed by the great human touch that was deep down in Sir Ernest Benn's heart.

Notes and Reports from the Societies

Society of Dyers and Colourists

Recent Developments in Dyestuffs

A JOINT meeting of the Manchester Sections of the Society of Dyers and Colourists, the Oil and Colour Chemists' Association, and the Chemical Section of the Manchester Literary and Philosopical Society was held in the Reynolds Hall of the Manchester College of Technology, on December 13, when Dr. R. Fraser Thompson read a paper upon the subject of "Vat Dyestuffs containing only Carbon, Hydrogen and Oxygen" for cotton dyeing.

Historically, said Dr. Thompson, the main land marks in the story were the discovery of indanthrone by Bohn in 1901 and of benzanthrone and dibenzanthrone in 1910 by Bally. While indanthrone was the fundamental vat colour other than indigo, dibenzanthrone was the first vat dyestuff containing no element other than carbon, hydrogen and oxygen. The further development of the field was greatly accelerated by the discovery of the valuable green dimethoxydibenzanthrone (Caledon Jade Green) in 1921, and research was still being actively pursued to discover new complexes. The vat dyestuffs of this class depended for their properties on a characteristic aromatic structure of fused benzene rings, with at least one pair of carbonyl groups linked by a conjugated chain of carbons in order to provide the mechanism for reduction and re-oxidation. The dye itself, in aqueous solution prepared by alkaline reduction of the commercial dyestuff, consisted of the leuco compound of the quinonoid substance, and after impregnation of the cotton with this, re-oxidation by air left the quinonoid form of the dyestuff attached very firmly to the fibre. This, in general, led to a high degree of fastness to washing, rubbing, etc.

Aromatic Quinonoid Structures

The growth of affinity in complex aromatic quinonoid structures presented a fascinating study, and two sets of compounds, derived from naphthalene, pyrene and perylene were compared by the lecturer. It was notable that while benzene, napthalene, anthracene and pyrene were colourless substances, perylene with five fused benzene rings, was yellow to orange in colour. In the first set were mentioned benzanthraquinone and diphthaloylnaphthalene (no affinity), dibenzopyrenequinone and anthanthrone (poor affinity, rendered satisfactory by halogenation) and pyranthrone (good affinity). The satisfactory dyes of this class were all yellow in colour, changed towards red by halogenation. In the second set, derived from perylene, were mentioned the dibenzoperylenequinone (red violet—no affinity), recently described independently by Scholl and Heilbron, normal and isodibenzanthrone (high affinity) and dimethoxydibenzanthrone (very good affinity). The remarkable influence of the methoxy groups on the shade and properties in the latter case was described in some detail, as it was only the 2.2′-methoxy groups which possessed this property.

Tests on Cotton Fibre

The parent dihydroxydibenzanthrone, prepared in one typical way by the oxidation of dibenzanthrone, was useless as a vat dye, but its colour reactions illustrated very vividly the chemistry of the class and were demonstrated by the lecturer by dye tests on cotton fibre. Dimethoxydibenzanthrone also exhibited beautiful colour reactions. It dissolved in strong sulphuric acid with a cherry red colour. This was turned brilliant jade green by nitric acid. The latter solution contained dimethoxydibenzanthrone in a very unstable state, demethylated by dilution in water, but which could be restored to the stable red solution, unaffected by dilution with water, by reducing back with copper bronze. These reactions probably indicated that the red solution contained a definite compound, *e.g.*, an oxonium sulphate, split by nitric acid.

Society of Chemical Industry

South Wales Section : Workers' Safety in Industry

THE part played by the chemist in maintaining the safety of workers in industry was discussed by scientists at a joint meeting of the South Wales Section of the Society of Chemical Industry and the Institute of Chemistry at University College, Cardiff, on December 13.

Mr. J. Davidson Pratt, the principal speaker, said that in the last few years increasing attention had been given to the protection of the worker against the hazards to life and limb which he might have to encounter in carrying out his normal duties in factory, mine and workshop. While this safety campaign had been inspired by humanitarian motives, one was beginning to realise more and more that the prevention of accidents and the safeguarding of the health of workers was a paying proposition, and that time and money spent in promoting safety would be more than repaid by increased efficiency and reduced charges for insurance, compensation and repairs. An American insurance company had studied this problem on an accountancy basis, and had definitely shown that safety paid. It had also been proved, time after time, that a safe works was an efficient works.

Accidents in Industry

Accidents in industry, said Mr. Pratt, may be roughly divided into two classes, namely, non-technical or general accidents, which are more or less common to all industries, such as falling off ladders, getting caught in machinery, and the like; and technical hazards, which arise from the nature of the operations and the materials employed or produced. The former class of accidents can be eliminated by the adoption of physical safeguards and "good housekeeping," by which is meant having everything in its proper place and in proper condition; and by instilling due regard for care into all members of the staff. The technical hazards, which include those in the prevention of which the chemist can and must play an important part, are due to the properties of matter and its transformations. In this category are to be included the dangers of fire, explosion, gassing, corrosion, uncontrolled reactions and the like. Only a chemist can appreciate and foresee all the reactions that may take place, and the dangers that they may involve to life and limb. Not only should the chemist be responsible for determining the nature of the hazards that might occur in manufacture or industry, but on him depended the nature of the precautions to be taken. Among these latter were to be included the provision of adequate ventilation and the design and production of efficient gas masks and suitable protective clothing, each of which, by itself, would constitute enough material for an address.

Detection of Toxic Gases

A word of warning was given about the dangers of using white mice for the detection of toxic gases. The present regulations, explained Mr. Pratt, implied that white mice would in all cases give an indication of gassing before men were affected; in other words, the mice would be more sensitive than human beings and show signs of distress before harm had been done to man. This has long been an established fact in the case of carbon monoxide, but to extend it to other gases at once leads to serious dangers. The mouse is not always more sensitive than man, and furthermore in the case of gases with delayed action, the damage will be done before the mouse shows any signs. Hence, to rely on white mice with toxic gases other than carbon monoxide is to court disaster. When this point was raised with the Home Office, they at once took expert physiological opinion which confirmed the contentions mentioned.

As an indication of the dangers of toxic gases in the atmo-

sphere, Mr. Pratt mentioned the problem of nitrous fumes. These fumes are one of the most dangerous forms of industrial poisoning because of their insidious character. It is practically impossible to foretell the seriousness of the after-effects from the initial symptoms. For example, one part in 4,000 is rapidly fatal even for short exposure; one part in 7,500 dangerous; whilst one part in 17,000 causes immediate irritation to the throat and one in 10,000 causes coughing. The maximum concentration allowable for long exposure is one part in 25,000. From this it will be apparent that a concentration which is dangerous to inhale for even a short time, may be hardly noticeable, because no disagreeable symptoms may be produced.

Bristol Section : Problems of River Pollution

LECTURING on December 2 before the Bristol and South Western Counties Sections of the Society of Chemical Industry, Dr. A. Parker, Assistant Director of Water Pollution Research under the Department of Scientific and Industrial Research, gave some striking examples of the amount of river pollution modern industries are liable to cause. The quantity of waste water from a beet sugar factory of average size, Dr. Parker stated, is approximately 3 or 4 million gal. per day. In the case of effluents from dairies and milk products factories, the polluting effect of the washing waters from a milk collecting and distributing depôt handling 10,000 gal. of milk per day is about the same as that of the domestic sewage from a population of 1,000 people. As the total quantity of milk produced in this country is more than 1,000 million gal. per annum, the total quantity of waste washing waters is roughly equivalent to the sewage from a population of 400,000. If whey is discharged to a stream instead of being utilised, its effects may be disastrous, as whey is at least 100 times as polluting in character as an equal volume of domestic sewage. With regard to the problem of disposal of effluents from dairies and milk products factories, also, the work of the Board has already indicated that the washings from churns, other equipment and factory premises can be satisfactorily purified by oxidation by processes similar to those in operation at many sewage disposal works. In the case of beet sugar factories, investigations completed by the Water Pollution Research Board have shown that after simple preliminary treatment the waste waters can be re-used in the factory processes and there need be little or no effluent for disposal. If necessary, the effluent can be effectively purified before discharge by biological oxidation in percolating filters.

Cost of Disposal of Sewage

With regard to the disposal of domestic sewage, Dr. Parker said that there are methods of treatment in use in many districts, particularly in the larger inland towns, whereby the sewage liquid can be purified sufficiently to allow of its discharge into most rivers and streams without causing serious pollution. These methods, however, are an expense to the community and the total costs including sewerage amount to several shillings per year per head of the population. The expense is undoubtedly justified, but it is highly probable that by systematic scientific investigation the methods can be improved or rendered less costly. One problem which has not yet been satisfactorily solved is that of the disposal of sewage sludge. Some of the sludge after a certain amount of drying is sold as a fertiliser, but it does not always find a ready market.

As examples of methods of dealing with problems of river pollution, Dr. Parker then referred to the important work of the Water Pollution Research Board appointed by the Department of Scientific and Industrial Research in 1927. This Board, besides initiating a number of investigations in connection with the treatment and disposal of waste waters from beet sugar factories, the treatment and disposal of effluents from dairies and milk products factories, was studying the processes of water softening, the causes of the corrosive and lead dissolving action of certain waters on mains and service pipes, and chemical and biological problems associated with processes of purification of sewage. In addition, a comprehensive chemical, biological and hydrographical survey of the River Tees has been carried out and an investigation of the River Mersey is in progress.

Continental Chemical Notes

Belgium

IMPROVED CONDITIONS IN THE SULPHURIC ACID MARKET have led to reopening of their idle works by S. A. Produits Chimiques de Tesenderloo.

Poland

CASEIN ARTIFICIAL HORN is now being manufactured by the Biezanow Co., near Cracow. It is intended to market the product under the name of "Kaloli."

ACCORDING TO A WARSAW REPORT (quoted in the "Chemische Industrie") the firm of K. Zawadski and Co. has embarked upon the manufacture of a range of cyanides, including those of zinc, cadmium, copper, mercury, silver and gold.

Hungary

A MODIFICATION OF THE BERGIUS PROCESS which has been developed by Professor J. Varga, of the Budapest Technical High School, with the object of producing petrol from tar products and petroleum residues is to be exploited by the newly registered Hungarian Hydrobenzine Co. (Magyar Hydrobenzin rt.) whose capital is 1,000,000 Pengo. The company's headquarters are at Pet, where it has taken over the experimental plant erected last year.

France

THE FIRST BITUMINOUS COAL HYDROGENATION PLANT in France was inaugurated on December 9 at the Béthune mines near Lille.

REFERENCE TO IMPENDING DEVELOPMENTS in the manufacture of hydrogenated fuel is contained in the annual report of Huiles, Goudrons et Dérivés, presented before the annual meeting of shareholders. Semi-industrial study of the technique of coal hydrogenation has been pursued for some years at the Vendin experimental works, the results of which will be exploited by a new company. Among important advances made during the year were enlargement of the phenol plant and extensions to the synthetic resin department with a view to the marketing of new moulding powders.

Germany

A COAL HYDROGENATION PLANT to be operated by the Fischer process will shortly be constructed by the Rheinpreussen concern. An annual production of 25,000 tons liquid fuel is anticipated from the first unit which is expected to be operating in the course of 1936.

RAT DESTRUCTION IS THE LATEST USE proposed for solid carbon dioxide, the animals being suffocated in their sleep by inserting in the morning small lumps of the material in the holes and stopping up the entrances with earth or plaster of paris ("Chemiker-Zeitung," December 11).

REVIEWING THE PROSPECTS OF GERMAN OIL-DRILLING OPERATIONS in an address before the German Society for Mineral Oil Research, Professor A. Bentz pointed out that greatest hopes were centred in the North German plain where the existence of four main producing fields had been established at Wietze, Nienhagen, Eddesse and Obberg, all of which were situated at the edge of brine formations. In recent months a fifth field of similar structure has been located near Hoheneggelsen-Molme and yielded 915 tons of oil in August ("Chemische Fabrik," December 11).

Personal Notes

DR. CHARLES DREYFUS, formerly well known as managing director of the Clayton Aniline Co., Ltd., died in Mentone on December 11, aged 86. He was born at Mulhouse in Alsace, and was distantly related to the famous Captain Alfred Dreyfus. He came to England in 1869 as chemist to a printing company at Radcliffe, and soon launched out on his own account. He retired from the management of the Clayton company in 1913, but returned to work during the war, manufacturing high explosives at Trafford Park. He was one of the founders of the Jewish Hospital, of which he was president, and presided also over the Manchester branch of the Zionist Association. He was a magistrate for 35 years.

Dr. Charles Dreyfus.

THE EARL OF DUDLEY has been elected president of the British Gas Federation in succession to Lord Macmillan.

MR. M. R. DHAR, D.Sc., F.I.C., has published a booklet entitled "Influence of Light on Some Biochemical Processes."

MR. JOHN L. CHARLTON, B.Sc., of Burnbank, has been appointed as bacteriologist at the experimental farm of Imperial Chemical Industries, Ltd., at Maidenhead.

MR. M. C. LAMB, F.C.S., has been elected president of the British Section of the International Society of Leather Trades' Chemists. The other officers for 1936 are: Vice-president, DR. R. H. MARRIOTT; treasurer, DR. D. BURTON, F.I.C.; hon. secretary, MR. R. FARADAY INNES, F.I.C.; members of committee, DR. A. TURNBULL, DR. C. H. SPIERS and MR. A. HARVEY.

VISCOUNT LEVERHULME, a past president of the Institution of Chemical Engineers, was granted a decree nisi by Mr. Justice Langton in the Divorce Court on Tuesday. The Judge exercised his discretion in Viscount Leverhulme's favour in respect of his own admissions of misconduct in 1934 with a Mrs. Winifred Lee Morris, whom he desired to marry. Viscount Leverhulme alleged the misconduct of Viscountess Leverhulme (formerly Marion Beatrice Bryce-Smith) with Major Selden Herbert Long, who was cited as co-respondent. A cross-petition of Lady Leverhulme for divorce was dismissed.

MR. ALFRED G. WATERHOUSE, J.P., a director of Peter Spence and Sons, Ltd., chemical manufacturers, was the recipient of two interesting presentations at the head office of the company at Manchester on December 13 on his completion of fifty years' service with the company. The gift from the directors took the form of a mahogany bureau and a cheque, and that from the staffs in Manchester, Widnes, Goole and London a mahogany grandmother electric clock. A gold wristlet watch was also presented to Mrs. Waterhouse. Mr. Waterhouse, in suitably responding, mentioned that eighteen members of the present staff gave aggregate years of 560, an average of 31 years each. On December 14, 1885, Mr. Waterhouse entered the firm as office boy, passing on to a clerk, and in 1898 was appointed a representative. In 1929 he was appointed a director. He has for over thirty years been interested in the purification of sewage and drinking water, and is well known to a large number of municipal engineers and surveyors and water engineers all over the country, and has recently been elected an honorary member of the Institute of Sewage Purification. He has also been actively associated with the paper manufacturing trade. In 1924 he was placed on the Magisterial bench for Salford, the city of his adoption 49 years ago.

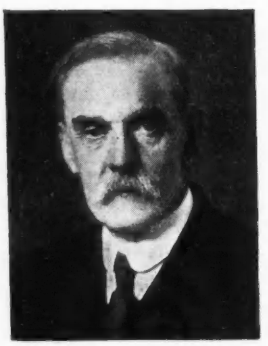
MR. THOMAS HERD was appointed chairman of the Distillers Co., Ltd., on December 12, in succession to Mr. W. H. Ross.

DR. L. H. LAMPITT, F.I.C., will lecture to the Royal Society of Arts on "Food and the World" on January 15. The meeting will be presided over by Dr. E. F. Armstrong.

MR. MOSS, a chemist, of Clyde Street, Ashton-under-Lyne, carried at great risk a quantity of high explosives to safety when a fire occurred in the laboratory of oil refiners in New Bailey Street, Salford, on December 12.

MR. BALDWIN announced in the House of Commons on December 17 that the King had approved the appointment of the following to serve on the Royal Commission which is to inquire into the provisions for the safety of workers in mines:—LORD ROCKLEY, chairman, JUDGE G. C. ALLSEBROOK, SIR MALCOLM DELEVINGNE, SIR HENRY WALKER, MR. D. R. GRENFELL, MR. E. O. F. BROWN, MR. E. EDWARDS, MR. W. T. MILLER, MR. W. H. TELFER, and MR. JOHN WALKER. The secretary to the commission is MR. E. W. RAVENSHEAR, of the Mines Department.

SIR RICHARD GLAZEBROOK, K.C.B., K.C.V.O., the distinguished scientist and a former chairman of the Aeronautical Research Committee, died on December 16, aged 81 years. He was educated at Dulwich College, Liverpool College, and Trinity College, Cambridge. Sir Richard began his career as University Lecturer in Mathematics at Cambridge in 1881. Later, after holding the post of Assistant Director of the Cavendish Laboratory, he was appointed Principal of University College, Liverpool, in 1898. In the following year he became the first Director of the National Physical Laboratory, a post which he held until 1920, when he became the first occupant of the Zaharoff Chair of Aviation, tenable at the Imperial College of Science and Technology in London. After the war he served as a member of the Air Inventions Committee and several other committees dealing with questions of aviation; and while at the Imperial College of Science and Technology he also became Director of the Department of Aeronautics. Sir Richard was a Fellow of the Royal Society, and was their foreign secretary between 1926 and 1929. He was created a Knight in 1917, received his K.C.B. in 1920, and was made a K.C.V.O. in 1934. In 1933 he was awarded the Gold Medal of the Royal Aeronautical Society, the highest honour which that Society can confer, and one which had only been awarded on six previous occasions. He had also received the Albert Medal of the Royal Society of Arts.



Sir Richard Glazebrook.

THE "Achema VIII" exhibition of chemical plant, organised by the Dechema Deutsche Gesellschaft für chemisches Apparatewesen E.V. (German Chemical Plant Association), will be held in Frankfort early in September, 1937, together with the 50th general meeting of the Verein Deutscher Chemiker.

THE wage agreement between the employers and employees in the superphosphate factories in Sweden has been extended through 1936. The only change was an increase in the vacation period from four to five days. Aktb. Forenade Superfostatfabriker, Halsingberg, is the only manufacturer of superphosphate in Sweden and operates factories in Landskrona, Stockholm, Limhamn and Malmo. Their combined output dropped from 219,026 metric tons in 1933 to 208,702 in 1934.

From Week to Week

AMBER SIZE AND CHEMICAL CO., LTD., 61 St. Mary Axe, E.C., have changed their name to Amber Chemical Co., Ltd.

OLD FINSBURY STUDENTS are asked if they will make a note, in good time, of the date of the next annual dinner, which takes place on March 21 at the Trocadero.

THE WEARING OF SAFETY BELTS by workmen in coal hoppers was discussed at an inquest at Hoyland, on December 4, on George Fletcher (23), coke oven worker, of Wombwell, who was suffocated through falling down a coal hopper at the chemical works at Wharncliffe Silkstone Colliery, Hoyland, into crushed coal.

A PENDING MERGER with a well-known plaster manufacturing concern is announced by British Plaster Board, Ltd. A circular to the shareholders says that a provisional agreement has been entered into with the object of acquiring the whole or not less than 90 per cent. of the share capital of Cafferata and Co., Ltd. The agreement, it is pointed out, is by way of amalgamation, the shareholders of Cafferata and Co. accepting ordinary and preference shares and a cash payment in exchange for their shares.

A VERDICT of accidental death was returned at an inquest at Bromsgrove on December 6 on Bert Bache (39), of Wychbold, who fell into a pan of boiling brine at Stoke Prior Salt Works on November 23. Dr. Auld said that death, which took place on December 5, was due to toxæmia due to extensive scalds. Bache told him he tried to save himself after a slip by clutching at the side of the pan, but it proved too hot to hold. He had to let go with his right hand, but dragged himself out with his left arm, which hung over the side of the pan.

THE ANNUAL STAFF DINNER of the Leeds and Sheffield Divisions of the National Benzol Co., Ltd., was held in Leeds for the first time on December 13 at the Hotel Metropole. Mr. E. G. Butler, Leeds divisional manager, presided. In the speeches the undeniable value of Press advertising, particularly in Yorkshire, was emphasised, as it had enabled the company to acquaint users of motor spirit of the fact that National benzol is made in Britain, from British coal, large quantities being produced in Yorkshire, including Leeds. Reference was made to the effect of this policy in creating additional employment and stimulating the coal, iron and steel trades.

A LECTURE ON "Physical Properties of some Synthetic Plastics" was given to the Plastics Group and the Newcastle Section of the Society of Chemical Industry at Armstrong College, Newcastle, on December 13, by Dr. A. Caress and Mr. P. A. Hull, both of Imperial Chemical Industries at Billingham. Dr. L. A. Jordan, chairman of the Group, attended. The lecturers expressed the opinion that plastics, in view of their wide range of properties—mechanical, optical, thermal and electrical—would occupy a large and increasing field as light structural materials, and as they could be obtained in the state to be capable of moulding by a variety of techniques, or in a state to be sawn and drilled like hard woods and in a variety of colours and designs, they could expect that plastics would couple adornment with utility.

A NEW FIVE-DAY WEEK SCHEME, applying to all employees of Lever Brothers, Ltd., and their associated companies all over the country, is to be put into operation in the new year. The scheme affects 2,500 of the company's employees in London, including the staff at Lever House. Details were conveyed to employees in this statement by the company: "As from January 1, 1936, all adult workers with six months' service in the soap factories of Lever Brothers, Ltd., and their associated companies will be guaranteed a full week's wages irrespective of the hours worked. This is an extension of our scheme whereby adult workers with four years' service have been guaranteed a substantial part of a full week's wage. Similar extensions have been made to the company's unemployment, sickness, and accident benefit schemes." As far as possible, Saturday work will cease. The arrangement will involve a reduction in working hours, without loss of pay.

PROFESSOR MACARTHUR, in an address on November 22 to the Andersonian Chemical Society entitled "The Chemist and the Farmer," said that the soil was of primary importance not only to the farmer, but to the nation. It might be regarded as a system formed by the association of matter in the solid, liquid and gaseous state. Soil analysis, conducted by the conventional methods of pure chemistry, did not furnish much useful data which could be used in guiding a farmer in problems of manuring. It was generally necessary to replenish the supply of nitrogenous, phosphatic and potassium compounds in the soil. In addition, it had been shown recently that small amounts of other elements might have a profound influence upon the growth, health and quality of a crop. Owing to the increased use of fertilisers and the diminished use of lime, many of the arable soils had become depleted of bases. The practice of liming the land must be undertaken with due discrimination. Some crops were tolerant of a slight acidity and were less liable to disease when grown under such conditions, while for others neutrality was demanded.

THE REGISTERED OFFICES of United Water Softeners, Ltd., are now at Permutit House, Gunnersbury Avenue, Chiswick, W.4.

MR. H. J. CURTIS, of Lewis Berger and Sons, Ltd., lectured on "Synthetic Finishes," under the auspices of the Institute of the Motor Trade at various South Western towns during the week ending December 14.

COAL AND ALLIED INDUSTRIES, LTD., announce that a fire occurred at the company's plant at Seaham Harbour during the night of December 13-14. So far as can be ascertained, the damage is confined to the carbonising battery. The cause of the damage was accidental and in no way due to the process. It is estimated that six weeks will elapse before the plant can again be put into operation.

WORKERS IN THE LIGHT METAL TRADES were successful on December 14 in their demand for a restoration of wages cuts imposed in 1928. Further cuts imposed in 1931 were restored last year. Mr. Adam Bennett, secretary of the Joint Committee of Light Metal Trades Unions, whose headquarters are at Rotherham, said that this success was achieved at a meeting with the National Light Castings Ironfounders' Federation at York. The cuts, which affected 20,000 men, will be restored on March 2.

Company News

Yorkshire Dyeware and Chemical Co.—The payment of 2½ per cent., less tax, on the ordinary shares is announced.

Bussey Coal Distillation.—The report to June 30 shows office expenses £251, against £264, professional charges £213, loss on furniture £25, patents renewals £46 (£132), directors' and auditors' fees £1,063, making £1,598 (£1,822), less sundry receipts £16 (£32), leaving debit £1,582 (£1,790). Add debit £220,223 (£218,433) brought in, making debit £221,805 forward.

Phospherine Products.—For the year to June 30 last the report shows trading profit £3,245; after writing off costs of capital reduction scheme and a further sum of £791 from Phosferine Products Rights as valued at date of reorganisation and placing £1,000 to reserve, available balance is £1,178. The dividend of 8 per cent. (against nil) absorbs £800, leaving to go forward £378.

British Benzol and Coal Distillation.—The report for the year to October 31 last shows trading profit £18,643, against £16,179; after charging overhead expenses, bank and debenture interest, tax, etc., and allowing £13,531 for depreciation, loss is £4,811, against £8,577. Adding debit balance of £88,093 brought in makes a total debit of £92,904 carried forward.

Milton Proprietary.—The profits amounted to £47,250 in the year to September 30 last, against £36,341 in the previous nine months. The final ordinary dividend is 17½ per cent., making 25 per cent., compared with the previous annual rate of 15 per cent. The carry-forward is increased from £88,371 to £98,897, after placing £7,313 to tax reserve.

Bleachers' Association.—It is announced that the directors have decided not to pay any interim dividend on the £2,487,500 5½ per cent. cumulative preference stock. Dividends on this stock are in arrear since June 30, 1933. No distribution has been made on the £3,818,737 ordinary capital since 1929-30, when 6⅔ per cent. was paid.

United Indigo and Chemical Co., Ltd.—At a meeting of the directors held on November 30, 1935, it was decided that a dividend at the rate of 5 per cent. per annum, subject to Income Tax at 4s. 6d. in the £ for the six months ending December 31, 1935, be paid in respect of the preference shares, and that the preference transfer books be closed from December 23 to the 31 inclusive.

Illingworth Carbonization Co.—The report to August 31 shows development and research expenditure brought £62,082, plus £22,722 debit for year, making £84,804. The report states that the loss on Compagnie de Carbonisation Illingworth has been written-off in the accounts presented. The loss incurred by the company in connection with the winding-up of T. and R. W. Bower (Illingworth) Carbonisation Co. have also been written off.

Leeds Fireclay Co.—In their report for the year to June 30 last, the directors report that "since June the company has been operating at a substantial profit, and they anticipate being able to declare an interim dividend on the preference shares early in 1936." The report discloses a net loss of £11,986, which compares with a debit balance of £28,477 for the preceding year, excluding the special credit of £18,700 in respect of the conversion of mortgage debt of Coal Conversion, Ltd. As in 1933-34, the debit balance is met by a transfer from reserve, reducing that fund to £232,963. No preference dividend has been paid since 1931, but payments on the £500,000 6 per cent. participating preference capital are non-cumulative. The last payment on the £100,000 ordinary capital was in respect of 1930-31.

Weekly Prices of British Chemical Products

Review of Current Market Conditions

THERE are no changes to report in the market prices for heavy chemicals, wood distillation products, pharmaceutical and photographic chemicals, perfumery chemicals and intermediates. In the rubber chemical section the price of vermilion, pale or deep, has been advanced from 4s. 8d. to 5s. 1d. per lb. Among tar products the price of naphthalene, purified crystals, has been raised from £14 5s. to £15 5s. per ton. There have been two price reductions in essential oils, Java cananga having dropped from 14s. to 12s. per lb., and Japanese peppermint from 6s. 3d. to 6s. Unless otherwise stated the prices below cover fair quantities net and naked at sellers' works.

LONDON.—There have been active conditions in the market on account of contract business for 1936, and the bulk of these contracts would now appear to be placed. Prices on the whole continue unchanged with markets firm.

MANCHESTER.—There has been a moderate flow of contract orders on the Manchester chemical market during the past week and sellers state that, in the aggregate, business booked during the past month or so for delivery next week has been on a satisfactory scale. Definite indications have not been wanting this week, however, of a seasonal slowing down, and during the coming fortnight fresh business is expected to be on the customary quiet lines. Moreover, deliveries against contracts will also be seriously affected, stocktaking operations being an additional influence in this respect, and notices of the suspension of deliveries of pretty well the full range of chemicals from the end of the present week hav been received. The market position generally remains very steady, and in the case of the by-products further advances in several sections have occurred since last report.

SCOTLAND.—Business in general chemicals has been rather quiet during the week, both for home trade and export. Prices, however, continue very steady at about previous figures with only slight changes to report.

General Chemicals

ACETONE.—LONDON: £62 to £65 per ton; SCOTLAND: £66 to £68 ex wharf, according to quantity.

ACID, ACETIC.—LONDON: Tech., 80%, £35 5s. to £37 5s.; pure 80%, £39 5s. to £41 5s.; tech., 40%, £20 5s. to £22 5s.; tech., 60%, £29 5s. to £31 5s. SCOTLAND: Glacial 98/100%, £48 to £52; pure 80%, £39 5s.; tech., 80%, £38 5s., d/d buyers' premises Great Britain. MANCHESTER: 80%, commercial, £39; tech. glacial, £52.

ACID, BORIC.—Commercial granulated, £27 per ton; crystal, £28; powdered, £29; extra finely powdered, £31; packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. B.P. cryst., £36; B.P. powder, £37. SCOTLAND: Crystals, £28; powdered, £29.

ACID, CHROMIC.—10½d. per lb., less 2½%, d/d U.K.

ACID, CITRIC.—11¾d. per lb. MANCHESTER: 1s. SCOTLAND: 11¾d.

ACID, CRESYLIC.—97/100%, 1s. 5d. to 1s. 6d. per gal.; 99/100%, refined, 1s. 9d. to 1s. 10d. per gal. LONDON: 98/100%, 1s. 5d. f.o.r.; dark, 1s.

ACID, FORMIC.—LONDON: £40 to £45 per ton.

ACID, HYDROCHLORIC.—Spot, 4s. to 6s. carboy d/d according to purity, strength and locality. SCOTLAND: Arsenical quality, 4s.; dearsenicated, 5s. ex works, full wagon loads.

ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £48; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £53; edible, 50% by vol., £41. One-ton lots ex works, barrels free.

ACID, NITRIC.—80° Tw. spot, £18 to £25 per ton makers' works. SCOTLAND: 80°, £24 ex station full truck loads.

ACID, OXALIC.—LONDON: £47 17s. 6d. to £57 10s. per ton, according to packages and position. SCOTLAND: 98/100%, £48 to £50 ex store. MANCHESTER: £49 to £54 ex store.

ACID, SULPHURIC.—SCOTLAND: 144° quality, £3 12s. 6d.; 168°, £7; dearsenicated, 20s. per ton extra.

ACID, TARTARIC.—1s. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. LONDON: 11½d., less 5%. SCOTLAND: 1s. 0¼d. less 5%. MANCHESTER: 1s. to 1s. 0¼d. per lb.

ALUM.—SCOTLAND: Lump potash, £8 10s. per ton ex store

ALUMINA SULPHATE.—LONDON: £7 10s. to £8 per ton. SCOTLAND: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM BICHROMATE.—8d. per lb. d/d U.K.

AMMONIUM CARBONATE.—SCOTLAND: Lump, £30 per ton; powdered, £33, in 5-cwt. casks d/d buyers' premises U.K.

AMMONIUM CHLORIDE.—LONDON: Fine white crystals, £18 to £19. (See also Salammoniac.)

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)

ANTIMONY OXIDE.—SCOTLAND: £61 to £65 per ton, c.i.f. U.K. ports.

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 1d. per lb.; crimson, 1s. 5½d. to 1s. 7d. per lb., according to quality.

ARSENIC.—LONDON: £15 per ton c.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines. SCOTLAND: White powdered, £23 ex wharf. MANCHESTER: White powdered Cornish, £21 10s., ex store.

ARSENIC SULPHIDE.—Yellow, 1s. 5d. to 1s. 7d. per lb.

BARIUM CHLORIDE.—LONDON: £10 10s. per ton. SCOTLAND: £10 10s. to £10 15s.

BARYTES.—£6 10s. to £8 per ton.

BISULPHITE OF LIME.—£6 10s. per ton f.o.r. London.

BLEACHING POWDER.—Spot, 35/37%, £7 19s. per ton d/d station in casks, special terms for contract. SCOTLAND: £9 5s.

BORAX, COMMERCIAL.—Granulated, £14 10s. per ton; crystal, £15 10s.; powdered, £16; finely powdered, £17; packed in 1-cwt. bags, carriage paid home to buyer's premises within the United Kingdom in 1-ton lots.

CADMIUM SULPHIDE.—4s. 10d. to 5s. 1d. per lb.

CALCIUM CHLORIDE.—Solid 70/75% spot, £5 5s. per ton d/d station in drums.

CARBON BISULPHIDE.—£31 to £33 per ton, drums extra.

CARBON BLACK.—3¾d. to 4⅛d. per lb. LONDON: 4½d. to 5d.

CARBON TETRACHLORIDE.—SCOTLAND: £41 to £43 per ton, drums extra.

CHROMIUM OXIDE.—10¾d. per lb., according to quantity d/d U.K.; green, 1s. 2d. per lb.

CHROMETAN.—Crystals, 3¼d. per lb.; liquor, £19 10s. per ton d/d.

COPPERAS (GREEN).—SCOTLAND: £3 15s. per ton, f.o.r. or ex works.

CREAM OF TARTAR.—£3 19s. per cwt. less 2½%. LONDON: £3 17s. per cwt. SCOTLAND: £3 16s. 6d. net.

DINITROTOLUENE.—66/68° C., 9d. per lb.

DIPHENYLGUANIDINE.—2s. 2d. per lb.

FORMALDEHYDE.—LONDON: £24 10s. per ton. SCOTLAND: 40%, £25 to £28 ex store.

IODINE.—Resublimed B.P., 6s. 3d. to 8s. 4d. per lb.

LAMPBLACK.—£45 to £48 per ton.

LEAD ACETATE.—LONDON: White, £36 10s. per ton; brown, £1 per ton less. SCOTLAND: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £36 10s.; brown, £34 10s.

LEAD NITRATE.—£32 10s. to £34 10s. per ton.

LEAD, RED.—SCOTLAND: £25 to £27 per ton less 2½%; d/d buyer's works.

LEAD, WHITE.—SCOTLAND: £39 per ton, carriage paid. LONDON: £42 10s.

LITHOPONE.—30%, £16 10s. to £17 per ton.

MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.

MAGNESIUM CHLORIDE.—SCOTLAND: £7 per ton.

MAGNESIUM SULPHATE.—Commercial, £5 per ton, ex wharf.

METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d. to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

PHENOL.—6¾d. to 7¼d. per lb. to June 30, 1936.

POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £39.

POTASSIUM BICHROMATE.—Crystals and Granular, 5d. per lb. less 5%, d/d U.K. Ground, 5¼d. LONDON: 5d. per lb. less 5%, with discounts for contracts. SCOTLAND: 5d. d/d U.K. or c.i.f. Irish Ports. MANCHESTER: 5d.

POTASSIUM CHLORATE.—LONDON: £37 to £40 per ton. SCOTLAND: 99¾/100%, powder, £37. MANCHESTER: £38.

POTASSIUM CHROMATE.—6¼d. per lb. d/d U.K.

POTASSIUM IODIDE.—B.P., 5s. 2d. per lb.

POTASSIUM NITRATE.—SCOTLAND: Refined granulated, £29 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 8¾d. per lb. SCOTLAND: B.P. crystals, 10d. to 10½d. MANCHESTER: B.P., 11¾d. to 1s.

POTASSIUM PRUSSIATE.—LONDON: Yellow, 8¼d. to 8¾d. per lb. SCOTLAND: Yellow spot, 8¼d. ex store. MANCHESTER: Yellow, 8¼d.

SALAMMONIAC.—First lump spot, £41 17s. 6d. per ton d/d in barrels. SCOTLAND: Large crystals, in casks, £36.

SODA ASH.—58% spot, £5 12s. 6d. per ton f.o.r. in bags.

SODA, CAUSTIC.—Solid, 76/77° spot, £13 17s. 6d. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums, £18 5s. in casks, Solid 76/77°, £14 12s. 6d. in drums; 70/73%, £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less. MANCHESTER: £13 5s. to £14 contracts.

SULPHATE OF COPPER.—MANCHESTER: £14 17s. 6d. to £16 per ton f.o.b.
SULPHUR CHLORIDE.—5d. to 7d. per lb., according to quality.
SULPHUR PRECIP.—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55.
VERMILION.—Pale or deep, 5s. 1d. per lb. in 1-cwt. lots.
ZINC CHLORIDE.—SCOTLAND: British material, 98%, £18 10s. per ton f.o.b. U.K. ports.
ZINC SULPHATE.—LONDON: £12 per ton. SCOTLAND: £10 10s.
ZINC SULPHIDE.—10d. to 11d. per lb.

Coal Tar Products

ACID, CRESYLIC.—90/100%, 2s. to 2s. 7d. per gal., according to specification; pale 98%, 1s. 9d. to 1s. 10d.; dark, 1s. 5d. to 1s. 6d. LONDON: 98/100%, 1s. 4d.; lark, 95/97%, 1s. SCOTLAND: Pale, 99/100%, 1s. 3d. to 1s. 4d.; dark, 97/99%, 1s. to 1s 1d.; high boiling acid, 2s. 6d. to 3s.
ACID, CARBOLIC.—Crystals, 6¾d. to 7¼d. per lb.; crude, 60's, 1s. 11½d. to 2s. 2½d. per gal. MANCHESTER: Crystals, 7¼d. to 7½d. per lb.; crude, 2s. 5d. per gal. SCOTLAND: 60's, 2s. 7d.
BENZOL.—At works, crude, 9½d. to 10d. per gal.; standard motor 1s. 3d. to 1s. 3½d.; 90%, 1s. 4d. to 1s. 4½d.; pure, 1s. 7½d. to 1s. 8d. LONDON: Motor, 1s. 3½d. SCOTLAND: Motor, 1s. 6½d.
CREOSOTE.—B.S.I. Specification standard, 5¾d. per gal. f.o.r. Home, 3¾d. d/d. LONDON: 4½d. f.o.r. North; 5d. London. MANCHESTER: 5d. to 5½d. SCOTLAND: Specification oils, 4d.; washed oil, 4½d. to 4¾d.; light, 4½d.; heavy, 4½d. to 4¾d.
NAPHTHA.—Solvent, 90/100%, 1s. 5½d. to 1s. 6½d. per gal.; 95/160%, 1s. 8d.; 90%, 11d. to 1s. 1d. LONDON: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. SCOTLAND: 90/160%, 1s. 3d. to 1s. 3½d.; 90/190%, 11d. to 1s. 2d.
NAPHTHALENE.—Crude, whizzed or hot pressed, £10 10s. per ton; purified crystals, £15 5s. per ton in 2-cwt. bags. LONDON: Fire lighter quality, £3 to £3 10s.; 74/76 quality, £4 to £4 10s.; 76/78 quality, £5 10s. to £6. SCOTLAND: 40s. to 50s.; whizzed, 70s. to 75s.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Brazil.—A commission agent in Rio de Janeiro desires the representation of United Kingdom manufacturers of sheet lead, galvanised corrugated and flat sheets, tin in strips and ingots and antimony in both powder and as metal. (Ref. No. 534.)

Brazil.—A commission agent in Rio de Janeiro desires the representation of United Kingdom firms of exporters of orange and T.N. shellac. (Ref. No. 535.)

South Africa.—H.M. Trade Commissioner at Johannesburg reports that the City Council of Johannesburg is calling for tenders to be presented in South Africa by January 4, 1936, for the supply of approximately 500 imperial gallons of liquid insecticide for deverminising. (Ref. T.Y. 184.)

South Africa.—H.M. Trade Commissioner at Johannesburg reports that the South African Railways and Harbours are calling for tenders, to be presented in Johannesburg by January 20, 1936, for the supply of quantities of vacuum and steam pressure gauges, and gauge dials, quadrants and pinions. (Ref. T.Y. 10268.)

Low Temperature Carbonisation

Diesel Oil Production

THE 18th annual general meeting of Low Temperature Carbonisation, Ltd., was held in London, on December 13, when Col. Whiston A. Bristow, chairman and managing director, presided.

For the first time, said Col. Bristow, the company can show a balance-sheet largely freed from the result of past difficulties, combined with a report as to the company's position and progress, marking a new era in the industry which the company has created. During the past year two events have been of great value and importance to the company, namely, the successful starting up of the great hydrogenation plant of Imperial Chemical Industries at Billingham, and the imposition of a tax of 8d. per gal. on Diesel oil used for road vehicles, from which home-produced oil is to be exempt. On April 5, 1935, the company sent off the first load to Billingham, where it was converted into approximately 100,000 gallons of petrol, and large quantities of oil have been despatched regularly to Billingham for some time past.

Over and above all the other factors which have this year reacted favourably upon the future is the question of oil supplies in war. Germany is rapidly building up a large organisation for the manufacture of petrol and oil from German coal and lignite. In that country a number of plants are being built and existing plants are being enlarged. By the end of 1936 the total production of petrol will amount to approximately 1,000,000 tons.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

(NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt as specified in the last available Annual Summary, is also given marked with an *—followed by the date of the Summary, but such total may have been reduced.)

Satisfaction

STAFFORD SALT AND ALKALI CO., LTD. (M.S., 21/12/35.) Satisfaction reg. Dec. 7, of debs. reg. Jan. 10, 1902, to Nov. 6, 1905, to extent of £5,200 the total issued.

Bill of Sale

MURRAY, HUMPHREY DESMOND, 9 Elm Place, Onslow Square, South Kensington, consulting chemist. (B.S., 21/12/35.) Dated Dec. 6. Filed Dec. 12. £50.

County Court Judgments

(NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court Judgments against him.)

MAUDSLEY, WILFRED, 5 Bridge Houses, Baxenden, chemical manufacturer. (C.C., 21/12/35.) £14 4s. 8d. Nov. 13.

COMMERCIAL LEAD LTD., Branstone, pigment manufacturers. (C.C., 21/12/35.) £12 12s. 6d. Nov. 13.

Receivership

MILTON BLEACHING AND CHEMICAL CO., LTD. (R., 21/12/35.) S. C. Davies, of 6 Shaw Street, Gee Cross, Hyde, Cheshire, was appointed receiver on December 6, 1935, under powers contained in debenture dated May 23, 1935.

The Sulphide Corporation, Ltd.

A Programme of Plant Alterations

PRESIDING at the 39th annual meeting of the Sulphide Corporation, Ltd., held in London, on December 13, Mr. Geoffrey C. Gibbs, the chairman, said sales of superphosphates and mixed manures amounted to 36,500 tons, which is an increase of more than 6,000 tons compared with the previous year, but the position of this industry is not satisfactory, owing to further reductions in price being made necessary to meet the extremely fierce competition from the neighbouring State of Victoria. As regards sulphuric acid, there was an increase in sales and we hope for and expect a further increase in demand in the future. There was also an increase in the production and sales of hydrochloric acid. The cement industry has had a most depressing time in New South Wales and it is a pleasure to be able to report a material improvement in demand.

The company has decided on a big programme of alterations and improvements to existing plants, which will involve considerable capital expenditure. The main expense is in the installation of a further unit to the contact acid plants, and there are alterations to the other plants which will result in a decrease in costs, and will, in general, bring the company's works into line with the most modern practice.

THE November shipments of china clay continue to show improvement on last year, and judging from the activity at the local ports the volume of business done in 1935 will be from 40,000 to 50,000 tons better than in 1934. Shipping at Fowey has been very good, whilst Par and Charlestown showed excellent returns for last month. The details for November are:—Fowey, 41,160 tons china clay, 3,675 tons china stone, 855 tons ball clay; Par, 9,330 tons china clay, 223 tons china stone; Charlestown, 6,747 tons china clay, 250 tons china stone; Pudstow, 608 tons china clay; Plymouth, 147 tons china clay; Newham, 77 tons china clay; by rail, 6,245 tons china clay; making a total of 69,317 tons, or 63,314 tons of china clay, 4,148 tons of china stone, and 855 tons of ball clay.

Chemical and Allied Stocks and Shares

Market Conditions During the Week

IMPERIAL Chemical ordinary shares, despite growing anticipations that the dividend will at least be maintained at 8 per cent., Unilever and other shares of companies which do a large overseas business were dull and are little changed on balance. Cooper, McDougall and Robertson have the same list price as a week ago at the time of writing, but business has been recorded up to the higher figure of 38s. 9d., there being continued hopes that the better Argentine exchange position may prove a favourable factor for the company. The shares are held firmly on the possibility of a larger dividend for the year, although it should be remembered that the directors invariably follow a conservative policy. Fison, Packard have kept their recent further gain. Distillers lost part of last week's rise but remained active, while United Molasses held up awaiting the annual meeting. William Blythe remained around 6s., and British Glues and Chemicals were less active although their recent further improvement was quite well maintained. British Cyanides continued more active on the attention drawn in the market to the fact that the yield appears on the large side. There was more attention given to Bradford Dyers issues, partly on vague talk that some form of agreement with Imperial Chemical Industries for close working in connection with dyeing processes may be in prospect. Monsanto Chemical preference have been steady at 23s. Midland Tar Distillers £1 ordinary shares were rather more active and are 28s. at the time of writing. Last year the dividend was 5 per cent., tax free, as for each of the two previous years, but it represented a conservative distribution of profits. Salt Union were in steady demand, reports of improvement in the company's export business having led to a wider recognition of the prospects of a larger dividend for the year. Dealings have commenced in the 4½ per cent. first mortgage debentures of L. B. Holliday and Co., the old-established Huddersfield dye manufacturers, and the price is around 101 at the time of writing. B. Laporte were again 115s., the disposition in the market being to value the shares mainly on the fact that last year 49 per cent. was actually earned on the ordinary capital. The dividend was limited to 20 per cent. United Indigo and Chemical were firm at Manchester at 2s. 3d. Last year the dividend was 5 per cent. on these 2s. shares. United Premier Oil and Cake more than maintained their recent further advance, aided by the estimate current in the market that the dividend for the year may be brought up to 12 per cent., compared with 7½ per cent. for the previous year, while British Oil and Cake Mills preferred ordinary were active although little changed on the week. The latter offer an apparently generous yield on the basis of their full dividend of 12½ per cent., and the dividend is considered in the market to be virtually guaranteed by the Unilever group. The shares rank for a 10 per cent. cumulative dividend and participate up to a further 2½ per cent. non-cumulative in any year when profits permit. Last year the maximum dividend was earned by a large margin. In other directions International Nickel remained a prominent feature among shares which have an active market on both sides of the Atlantic, anticipations having persisted that the company's earnings are continuing on the up-grade and that an increased dividend is likely. Turner and Newall responded to the favourable impression created by the report and accounts.

Name.	Dec. 17.	Dec. 10
Anglo-Iranian Oil Co., Ltd. Ord.	68/1½	68/9
,, 8% Cum. Pref.	36/-	37/-
,, 9% Cum. Pref.	37/-	38/3
Associated Dyers and Cleaners, Ltd. Ord.	2/6	2/6
,, 6½% Cum. Pref.	5/6¾	5/3¾
Associated Portland Cement Manufacturers, Ltd. Ord.	64/6	65/-
,, 5½% Cum. Pref.	28/-	28/-
Benzol & By-Products, Ltd. 6% Cum. Part Pref.	2/6	2/6
Berger (Lewis) & Sons, Ltd. Ord.	65/7½	65/7½
Bleachers' Association, Ltd. Ord.	6/3	7/6
,, 5½% Cum. Pref.	10/7½	12/6
Boake, A., Roberts & Co., Ltd. 5% Pref. (Cum.)	20/-	20/-
Boots Pure Drug Co., Ltd. Ord. (5/-)	49/6	49/6
Borax Consolidated, Ltd. Pfd. Ord. (£)	101/3	100/-
,, Defd. Ord.	19/-	17/6
,, 5½% Cum. Pref. (£10)	£11/5/-	£11/2/6
,, 4½% Deb. (1st Mort.) Red. (£100)	£107	£109
,, 4½% 2nd Mort. Deb. Red. (£100)	£102	£102
Bradford Dyers' Association, Ltd. Ord.	10/-	10/7½
,, 5% Cum. Pref.	12/6	12/6
,, 4% 1st Mort. Perp. Deb. (£100)	£87	£88
British Celanese, Ltd. 7% 1st Cum. Pfd.	25/6	25/6
,, 7½% Part. 2nd Cum. Pref.	23/-	23/3
British Cotton & Wool Dyers' Association Ltd. Ord. (5/-)	6/3	6/3
,, 4% 1st Mort. Deb. Red. (£100)	£92	£94
British Cyanides Co., Ltd. Ord. (2/-)	3/1½	3/1½
British Drug Houses, Ltd. Ord.	18/9	18/9
,, 5% Cum. Pref.	21/3	21/3
British Glues and Chemicals, Ltd. Ord. (4/-)	8/1½	8/1½
,, 8% Pref. (Cum. and Part.)	28/1½	28/1½
British Oil and Cake Mills, Ltd. Cum. Pfd. Ord.	48/9	48/9
,, 5½% Cum. Pref.	26/3	26/3
,, 4½% First Mort. Deb. Red. (£100)	£107/10/-	£108/10/-
British Oxygen Co., Ltd. Ord.	115/-	115/-
,, 6½% Cum. Pref.	32/6	32/6
British Portland Cement Manufacturers, Ltd. Ord.	85/-	85/-
,, 6% Cum. Pref.	30/6	30/6
Bryant & May, Ltd. Pref.	66/3	66/3
Burt, Boulton & Haywood, Ltd. Ord.	20/-	20/-
,, 7% Cum. Pref.	27/6	27/6
,, 6% 1st Mort. Deb. Red. (£100)	£105/10/-	£105/10/-
Bush, W. J., & Co., Ltd. 5% Cum. Pref. (£5)	112/6	108/9
,, 4% 1st Mort Deb Red (£100)	£96/10/-	£96/10/-
Calico Printers' Association, Ltd. Ord.	8/9	9/43
,, 5% Pref. (Cum.)	15/-	15/11·
Cellulose Acetate Silk Co., Ltd. Ord.	12/9¹	13/4
,, Deferred (1/-)	2/1½	2/1½

Name.	Dec. 17.	Dec. 10.
Consett Iron Co., Ltd. Ord.	10/3	11/6
,, 8% Pref.	30/-	28/9
,, 6% First Deb. stock, Red. (£100)	£107	£107/10/-
Cooper, McDougal & Robertson, Ltd. Ord.	37/6	28/9
,, 7% Cum. Pref.	30/-	30/-
Courtaulds, Ltd. Ord.	56/3	56/3
,, 5% Cum.	26/3	26/3
Crosfield, Joseph, & Sons, Ltd. 5% Cum. Pre-Pref.	25/-	25/-
,, Cum. 6% Pref.	28/9	28/9
,, 6½% Cum. Pref.	30/7½	30/7½
,, 7½% "A" Cum. Pref.	30/7½	30/7½
Distillers Co., Ltd. Ord.	97/-	98/6
,, 6% Pref. Stock Cum.	31/6	31/6
Dorman Long & Co., Ltd. Ord.	21/6	23/-
,, Pref. Ord.	29/4½	28/9
,, 6½% Non-Cum. 1st Pref.	23/-	23/3
,, 8% Non-Cum. 2nd Pref.	23/-	22/3
,, 4% First Mort. Perp. Deb. (£100)	£101/10/-	£102/10/-
,, 5% 1st Mort. Red. Deb. (£100)	£107/10/-	£106/10/-
English Velvet & Cord Dyers' Association, Ltd. Ord.	5/-	5/-
,, 5% Cum. Pref.	8/9	8/9
,, 4% First Mort. Deb. Red. (£100)	£72/10/-	£73/10/-
Fison, Packard & Prentice, Ltd. Ord.	45/-	45/-
,, 7% Non-Cum. Pref.	31/3	31/3
,, 4½% Debs. (Reg.) Red. (£100)	£106	£106
Gas Light & Coke Co. Ord.	27/6	27/9
,, 3½% Maximum Stock (£100)	£89/10/-	£89/10/-
,, 4% Consolidated Pref. Stock (£100)	£107/10/-	£107
,, 3% Consolidated Deb. Stock, Irred. (£100)	£90	£90
,, 5% Deb. Stock Red. (£100)	£116/10/-	£114/10/-
,, 4½% Red. Deb. Stock (1960-65) (£100)	£112/10/-	£112/10/-
Goodlass Wall & Lead Industries, Ltd. Ord. (10/-)	14/4½	14/4½
,, 7% Prefd. Ord. (10/-)	13/9	13/9
,, 7% Cum. Pref.	28/6	28/9
Gossage, William, & Sons, Ltd. 5% 1st Cum. Pref.	24/4½	24/4½
,, 6½% Cum. Pref.	28/9	28/9
Imperial Chemical Industries, Ltd. Ord.	37/-	37/-
,, Deferred (10/-)	9/-	9/-
,, 7% Cum. Pref.	33/6	34/-
Imperial Smelting Corporation, Ltd. Ord.	15/3	15/6
,, 6½% Pref. (Cum.)	24/3	24/3
International Nickel Co. of Canada, Ltd. Cum.	$43	$46¼
Johnson, Matthey & Co., Ltd. 5% Cum. Pref. (£5)	108/-	105/-
,, 4% Mort. Deb. Red. (£100)	£98/10/-	£98/10/-
Laporte, B., Ltd. Ord.	115/-	115/-

Name.	Dec. 17.	Dec. 10.
Lawes Chemical Co., Ltd. Ord. (1/-)	6/3	6/3
,, 7% Non-Cum. Part Pref. (10/-)	10/-	10/-
Lever Bros., Ltd. 7% Cum. Pref.	32/-	31/9
,, 8% Cum. "A" Pref.	33/6	33/6
,, 20% Cum. Prefd. Ord.	77/6	77/6
,, 5% Cons. Deb. (£100)	£106/10/-	£106/10/-
,, 4% Cons. Deb. (£100)	£105/10/-	£105/10/-
Magadi Soda Co., Ltd. 12½% Pref. Ord. (5/-)	1/3	1/3
,, 6% 2nd Pref. (5/-)	6d.	6d.
,, 6% 1st Debs. (Reg.)	£42	£42/10/-
Major & Co., Ltd. Ord. (5/-)	7½d.	7½d.
,, 8% Part. Prefd. Ord. (10/-)	9d.	9d.
,, 7½% Cum. Pref.	1/6¾	1/6¾
Pinchin, Johnson & Co., Ltd. Ord. (10/-)	42/-	43/-
,, 1st Pref. 6½% Cum.	32/-	32/-
Potash Syndicate of Germany (Deutsches Kalisyndikat G.m.b.H.) 7% Gld. Ln. Sr. "A" and "B" Rd.	£70	£71
Reckitt & Sons, Ltd. Ord.	115/7½	115/7½
,, 4½% Cum. 1st Pref.	24/4½	24/4½
Salt Union, Ltd. Ord.	43/9	43/9
,, Pref.	45/-	45/-
,, 4½% Deb. (£100)	£107/10/-	£109/10/-
South Metropolitan Gas Co. Ord. (£100)	£133/10/-	£133/10/-
,, 6% Irred. Pref. (£100)	£149/10/-	£149/10/-
,, 4% Pref. (Irred.) (£100)	£107	£107
,, Perpetual 3% Deb. (£100)	£88/10/-	£89/10/-
,, 5% Red. Deb. 1950-60 (£100)	£116/10/-	£116/10/-
Staveley Coal and Iron Co., Ltd. Ord.	47/6	47/6
Stevenson & Howell, Ltd. 6¼% Cum. Pref.	26/3	26/3
Triplex Safety Glass Co., Ltd. Ord. (10/-)	82/6	83/9
Unilever, Ltd. Ord.	29/4½	30/-
,, 7% Cum. Pref.	30/3	29/9
United Glass Bottle Manufacturers, Ltd. Ord.	44/6	44/6
,, 7½% Cum. Pref.	32/6	33/-
United Molasses Co., Ltd. Ord. (6/8)	21/3	20/-
,, 6% Cum. Pref.	25/-	25/-
United Premier Oil & Cake Co., Ltd. Ord. (5/-)	10/9	10/3
,, 7% Cum. Pref.	25/-	25/-
,, 6% Deb. Red. (£100)	£101/10/-	£102/10/-

Inventions in the Chemical Industry

Patent Specifications and Applications

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Open to Public Inspection

REFINING SELENIUM, method.—Bolidens Gruvaktiebolag. June 6, 1934. 3745/35.

CONVERSION OF POTASSIUM CHLORIDE or potassium fertiliser salts into sintered masses, process.—Kali-Forschungs-Anstalt Ges. June 7, 1934. 14385/35.

CONDENSATION PRODUCTS from primary aromatic amines and formaldehyde, manufacture.—Soc. of Chemical Industry in Basle. June 9, 1934. 16626/35.

Specifications Accepted with Date of Application

PRODUCTION OF POROUS SILICA GEL, method.—Imperial Chemical Industries, Ltd. (. Malan, G. G. H. Malan, and Cape Explosives Works, Ltd.). March 28, 1934. 439,237.

POTASSIUM SULPHATE, production.—I. L. Clifford, A. E. Cashmore, and Imperial Chemical Industries, Ltd. May 24, 1934. 439,287.

RECOVERY OF VALUABLE PRODUCTS from hydrocarbons.—Coutts and Co., and F. Johnson. May 30, 1934. 439,491.

HIGHLY ACETYLATED CELLULOSE, manufacture.—Cellulose Acetate Silk Co., Ltd., D. Hayes, H. Wood and F. Taylor. May 30, 1934. 439,245.

AROMATIC HYDROXY COMPOUNDS, manufacture and production.—Coutts and Co. and F. Johnson (I. G. Farbenindustrie). June 2, 1934. 439,356.

SUBSTITUTED AROMATIC AMINO-COMPOUNDS, manufacture.—I. G. Farbenindustrie. June 3, 1933. 439,295.

DYESTUFFS of the anthraquinone series, manufacture.—E. I. du Pont de Nemours and Co. June 3, 1933. 439,296.

CARBOCYANINE DYESTUFFS, manufacture.—I. G. Farbenindustrie. June 10, 1933. 439,359.

DIPHENYLMETHANE DERIVATIVES, process for the manufacture.—I. G. Farbenindustrie. June 9, 1933. 439,508.

1.4-DIHALOGEN-ANTHRAQUINONE-2-CARBOXYLIC ACIDS, process for manufacture.—I. G. Farbenindustrie. June 9, 1933. 439,509.

HYDROCARBON OILS, purification.—C. W. Stratford. June 8, 1934. 439,250.

HYDROCARBON OILS, treatment.—A. L. Mond (Universal Oil Products Co.). June 8, 1934. 439,430.

VALUABLE HYDROCARBONS by the cracking or destructive hydrogenation of carbonaceous materials, manufacture and production. Coutts and Co., and F. Johnson (I. G. Farbenindustrie). June 18, 1934. 439,366.

ZINC SULPHIDE PIGMENT, manufacture.—New Jersey Zinc Co. Dec. 15, 1933. 439,311.

BLUE DYESTUFFS on the fibre, manufacture.—Soc. of Chemical Industry in Basle. July 27, 1933. 439,256.

AZO DYESTUFFS, manufacture.—A. Carpmael (I. G. Farbenindustrie). July 17, 1934. 439,372.

COMPOSITE PIGMENTS containing titanium, preparation.—Titan Co., Inc. July 18, 1933. 439,312.

ARTIFICIAL RESINS, production.—H. D. Elkington (A. Nowack A.-G.) and Dr. R. Hessen). Aug. 17, 1934. 439,378.

INTAGLIO PRINTING INKS, manufacture and production.—Coutts and Co., and F. Johnson (I. G. Farbenmdustrie). Aug. 22, 1934. 439,524.

NITROGENOUS CONDENSATION PRODUCTS, manufacture and production.—Coutts and Co., and F. Johnson (I. G. Farbenindustrie). Sept. 10, 1934. 439,380.

ACRYLIC ACID ESTERS, polymerisation.—Dr. O. Röhm. Dec. 2, 1933. 439,390.

ALKYLATED IMIDAZOLES of high molecular weight, manufacture. Soc. of Chemical Industry in Basle. Dec. 15, 1933. 439,261.

PRODUCTION OF MAGNESIUM, process and apparatus.—I. G. Farbenindustrie. Dec. 22, 1933. 439,535.

VALUABLE PRODUCTS from coal varieties, tars, mineral oils, and the like, production.—International Hydrogenation Patents Co., Ltd. Jan. 10, 1934. 439,265.

DEHYDRATION FOR PLASTIC EARTH, process.—C. E. Blyth. Jan. 10, 1935. 439,332.

AZO DYESTUFFS capable of forming metal compounds and products resulting from this process, preparation.—Compagnie Nationale de Matières Colorantes et Manufactures de Produits Chimiques du Nord Réunies Etablissements Kuhlmann. Feb. 2, 1934. 439,451.

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OIL SOLUBLE RESINS, production.—Bakelite, Ltd. (United States, Dec. 11, '34.) 34249.

SYNTHETIC RESINS, production.—Bakelite, Ltd. (United States, Dec. 11, '34.) 34250.

STORING, ETC., LIQUEFIED FUEL GAS.—L. Blass. 34330.

ANTHRAQUINONE DERIVATIVES, manufacture.—A. G. Bloxam (Soc. of Chemical Industry in Basle). 34359.

ARTIFICIAL MATERIALS of cellulose derivatives, manufacture.—British Celanese, Ltd. 33750.

β-KETOACETALS, manufacture.—A. Carpmael (I. G. Farbenindustrie). 33976.

HALOGEN ETHYLKETONES and halogen vinylketones, manufacture. A. Carpmael (I. G. Farbenindustrie). 33977.

DEVICE FOR PREVENTING EVAPORATION of volatile products.—R. E. Cossais. (Luxembourg, Dec. 13, '34.) 34406.

ASBESTOS SLATES.—B. Davies and J. C. Jones. 33828.

ALLOY STEELS.—Deutsche Edelstahlwerke A.-G. (Germany, Dec. 7, '34.) 33876.

COOLING LIQUIDS, apparatus.—R. M. Drummond. 34204.

PURIFICATION OF EARTHY MINERALS, process.—W. Feldenheimer. 33854.

HIGH-VACUUM DISTILLATION.—R. G. J. Fraser and Imperial Chemical Industries, Ltd. 34090.

SOLUBLE TITANIUM SALTS of organic acids, manufacture.—D. Gardner. 34329.

ALUMINIUM, etc., producing.—H. E. Garrett. 33951.

INDULINES, manufacture.—W. W. Groves (J. R. Geigy A.-G.). 33851.

POLYVINYL DERIVATIVES containing nitrogen, manufacture.—W. W. Groves (I. G. Farbenindustrie). 34362.

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